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ABSTRACT

This document, one of eight in a multi-cultural competency-based vocational/technical curricula series, is on maintenance mechanics. This program is designed to run 40 weeks and cover 5 instructional areas: basic electricity (14 weeks): maintenance and repair of heating (4 weeks): maintenance and repair of air conditioning (12 weeks): maintenance plumbing (3 weeks): and maintenance carpentry (7 weeks). A duty-task index lists competencies in each instructional area that the student should be able to perform at the end of the program. For example, in the residential air conditioning section, a student should be able to (1) add oil to a hermetic system: (2) add refrigerant to a hermetic system: and (3) install a filter-drier. In section 1, each instructional task area contains a list of performance objectives, evaluation criterion, performance guide, and a list of tasks to be covered. In section 2, the introduction and duty-task index is repeated in English, Spanish, and Laotian. In section 3, a listing of technical terms concerning maintenance mechanics are listed in English, Spanish, and Laotian. (CT)

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Fiberglass
Automotive Mechanics
Machine Trades
Autobody Repair
Welding
Maintenance Mechanics
Clerical Cluster
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Career Development Center
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    English
    English/Spanish
    English/Laotian

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Product Abstract

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____ 22 Cooperative Education
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____ 7-8
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X 9-10
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MAINTENANCE MECHANICS series contains:

1. Competency-Based Curriculum in VESL.
2. Program Introduction and Outline in English; Laotian; and Spanish.
3. Lexicon of Technical Terms in VESL; English-Laotian; and English-Spanish versions.

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COMPETENCY-BASED CURRICULUM SERIES

MAINTENANCE MECHANICS

CAREER DEVELOPMENT CENTER
SCHOOL OF TECHNICAL CAREERS
SOUTHERN ILLINOIS UNIVERSITY
CARBONDALE, ILLINOIS

COMPETENCY-BASED VOCATIONAL/TECHNICAL CURRICULUM SERIES

MAINTENANCE MECHANICS

MASAKO T. SHIN, CURRICULUM SPECIALIST, STC, SIU-C

The preparation of this multicultural series was aided financially through funding agreements with the Illinois State Board of Education/Department of Adult, Vocational and Technical Education.

(Contract Numbers: R-33-10-C-0442-400, R-33-21-J-0542-400)

ARDEN L. PRATT, DEAN
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June 1981 LARRY HEPBURN, CENTER DIRECTOR

OUR GOAL

TO ACHIEVE THE MAXIMUM IN THE MINIMUM TIME

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INTRODUCTION

The purpose of the maintenance mechanics program is to provide the student with technical and vocational training integrated with practical experiences in all of the job classifications within the program.

The program runs 40 weeks covering 5 instructional areas: basic electricity (14 weeks); maintenance and repair of heating (4 weeks); maintenance and repair of air conditioning (12 weeks); maintenance plumbing (3 weeks); and maintenance carpentry (7 weeks). The class meets 2 hours each day in related education or G.E.D. classes, and 6 hours each day in occupational education (up to 2 hours of shop-lecture on technical theories and a minimum of 4 hours each day of practical shop experience). The program is a continuous circular instructional system with student input at the beginning of each curriculum.

Even though many industries always advertise for maintenance mechanics, their requirements are rather strict due to the fact that most maintenance departments are understaffed, underbudgeted and consequently overworked. Employers look for the type of individual, who has a high degree of maturity and reliability, who can function without direct supervision, who follows directions explicitly, and who has the motivation and initiative to take care of any given situation.

There is no substitute for experience. A person can find a job in maintenance provided he has a proven work record plus the technical skills and working knowledge of the field.

A maintenance mechanic is always the last to be laid off and the first to be rehired even in an adverse economic climate. If an individual can meet the above requirements, he or she can always find work in maintenance. The institutional, industrial, and housing authority areas are examples of where maintenance jobs can be found.

MAINTENANCE MECHANICS: DUTY-TASK INDEX

I. BASIC AIR-CONDITIONING

1. Use a voltmeter, ammeter and ohmmeter.
2. Trace a 120V electrical circuit. (Theory only)
3. Dismantle and assemble a single-phase motor.
4. Test an open type capacitor-start electric motor.
5. Check and adjust a thermostat. (Theory only)
6. Check a current relay.
7. Check a potential relay.
8. Check a thermal relay.
9. Check a solenoid valve.
10. Make electrical connections.
11. Test a capacitor-start hermetic motor.
12. Test and operate a capacitor-start, capacitor-run (CSR) hermetic motor.
13. Replace a relay and overload protector.
14. Replace a condensor fan motor.
15. Replace an evaporator fan motor.
16. Check all electrical components of a 120V air-conditioning system.
17. Check a 120V system with a 24V control circuit.
18. Trace the circuits and draw the wiring diagram for a commercial refrigerating system.

II. AIR-CONDITIONING

1. Remove, test, install and adjust a thermostatic expansion valve. (Theory only)
2. Remove, clean, install and operate an oil separator. (Theory only)
3. Remove, inspect, install and adjust a commercial type pressure motor control. (Theory only)
4. Install a remote air-cooled condenser. (Theory only)
5. Install and test a rooftop system. (Theory only)
6. Locate trouble in a water-cooled system. (Theory only)

III. RESIDENTIAL AIR-CONDITIONING

1. Add oil to a hermetic system.
2. Add refrigerant to a hermetic system.
3. Install a filter-drier.

IV. AIR-CONDITIONING

1. Measure relative humidity and dew point. (Theory only)
2. Measure air velocity in a duct using an anemometer. (Theory only)

IV. AIR-CONDITIONING (cont.)

3. Install and use a water manometer. (Theory only)
4. Measure air velocity in a duct using a pitot tube. (Theory only)
5. Measure air velocity in a duct using a velocimeter. (Theory only)
6. Measure pressure drop through a filter. (Theory only)
7. Install and operate airflow control. (Theory only)
8. Install a window type comfort cooler.
9. Install a residential central cooling system. (Theory only)
10. Install a rooftop comfort cooling system. (Theory only)
11. Install a heat pump. (Theory only)
12. Locate trouble in a window type comfort cooler.
13. Locate trouble in a heat pump. (Theory only)
14. Locate trouble in a residential central comfort cooling system. (Theory only)
15. Locate trouble in a water chiller. (Theory only)

V. HEATING

1. Install and operate an atmospheric gas burner with pilot light. (Theory only)
2. Install and operate a blower type gas burner with electric ignition. (Theory only)
3. Install and operate a gun type oil burner. (Theory only)
4. Check and connect a heating thermostat.
5. Check and connect a combination thermostat.
6. Remove, clean and replace an oil burner nozzle. (Theory only)
7. Remove, test and replace an oil burner motor. (Theory only)
8. Remove, test and install an oil burner primary control. (Theory only)
9. Remove, test and install an oil burner safety control. (Theory only)
10. Install a power humidifier in a duct system. (Theory only)
11. Balance airflow in forced air system. (Theory only)
12. Replace a pump on a hydronic system. (Theory only)
13. Install and operate an electric heating system. (Theory only)
14. Locate trouble in a gas burner system.
15. Make a stack flue gas analysis. (Theory only)
16. Operate and test a baseboard electric resistance heating system.

VI. PLUMBING - JOINING PIPE

1. Join cast-iron soil pipe, using lead and oakum.
2. Cut steel pipe with one-wheel cutter.
3. Join copper tubing/pipe to plastic pipe.
4. Using sweat method, join copper tubing/pipe to plastic pipe.
5. Join copper tubing to steel pipe.
6. Join plastic pipe, using solvent cement method.
7. Join plastic pipe to steel pipe.
8. Thread steel pipe with nonadjustable die.
9. Replace a section of galvanized water supply line.
10. Repair leaky water faucets or valves.

VII. PLUMBING - DRAINS

1. Install cleanouts on drains. (Theory only)
2. Lay out house drains. (Theory only)
3. Make water tests on building drains. (Theory only)
4. Rough-in waste and vent lines for bathtubs. (Theory only)
5. Rough-in waste and vent lines for built-in lavatories. (Theory only)
6. Rough-in waste and vent lines for floor-mounted water closets. (Theory only)
7. Clear obstructions from lavatory drains.
8. Remove obstructions from main drain lines.
9. Remove obstructions from water closet drains.
10. Replace lavatory trap drains.
11. Repair water flush valves on water closets.

VIII. PLUMBING - VENTS

1. Install soil or waste back vents. (Theory only)
2. Install vent terminals (roof-flashing). (Theory only)

IX. PLUMBING - AIR CONDITIONING AND HEATING

1. Bend copper tubing with spring bender.
2. Braze pipe with gas torch and filler metal.
3. Cut copper tubing with hacksaw.
4. Cut copper tubing with tubing cutter.
5. Join copper tubing/pipe to copper pipe/tubing.
6. Join copper tubing with compressed connectors.
7. Install temperature and pressure relief valves on boilers. (Theory only)
8. Clean deposits from boilers. (Theory only)

IX. PLUMBING - AIR CONDITIONING AND HEATING (cont.)

9. Perform leak tests on gas supply lines. (Theory only)
10. Clean and adjust gas burners. (Theory only)
11. Install check valves on water feed lines. (Theory only)
12. Install strainers in condensate-return lines. (Theory only)

X. CARPENTRY - BUILDING MATERIALS

1. Identify actual sizes of milled lumber in relation to nominal sizes.
2. Identify defects and blemishes that affect durability and strength of lumber.
3. Stack and care for lumber.
4. Identify job safety requirements.

XI. CARPENTRY - HAND AND POWER TOOLS

1. Use personal protective equipment.
2. Bore holes with drill press. (Theory only)
3. Check installation for level and plumb with a carpenter's level.
4. Copy and transfer angles using sliding T-bevel and framing combination squares as layout tools.
5. Read and measure with rules and squares.
6. Cut chamfers with table saw.
7. Cut compound miters with table saw.
8. Cut dado with portable router.
9. Cut irregular shaped patterns with saber and band saws.
10. Cut large sheets of plywood and wallboard with table saw.
11. Drill-bore holes with portable hand drill.
12. Glue wood stock with hand and bar clamps.
13. Joint stock with the jointer.
14. Make butt joints.
15. Make dado joints.
16. Make lap joints.
17. Make miter joints.
18. Make rabbet joints.
19. Plane stock to thickness with single surface planer (surfacer).
20. Rip plywood with portable saw.
21. Sand finish materials by hand.
22. Sand surfaces and edges with belt sander.
23. Select proper hammer and drive various types and sizes of nails.

XI. CARPENTRY - HAND AND POWER TOOLS (cont.)

24. Set nails with nail set and apply wood filler.
25. Service and maintain portable woodworking power tools.

XII. CARPENTRY - INTERIOR FINISH

1. Apply finishes.
2. Fit and hang interior doors.
3. Install dry-wall boards.
4. Install metal corners for dry wall.
5. Install entrance and interior door lock sets.
6. Trim interior door openings.

XIII. CARPENTRY - ROUGH FRAMING

1. Build saw horses.
2. Align and brace a wall from corner to corner.
3. Apply subbases over subfloors.
4. Build corner posts.
5. Frame exterior wall.
6. Frame and align a partition wall.
7. Frame and install a built-up "T" sill.
8. Frame and install box sills.
9. Frame built-up girders.
10. Frame floor opening. (Theory only)
11. Frame a wall opening.
12. Identify framing members. (Theory only)
13. Cut and install ceiling (frame) joists. (Theory only)
14. Install diagonal bracing.
15. Install firestops. (Theory only)
16. Install floor joists.
17. Install sill plates on foundation wall.
18. Install post and beam framing. (Theory only)
19. Install structural sheathing.
20. Lay subfloors.

XIV. CARPENTRY - ROOFING

1. Apply insulation (underlay) for asphalt shingles.
2. Build roof trusses.
3. Calculate the rise and run of a common roof.
4. Determine length of rafter scale.
5. Flash chimney. (Theory only)
6. Flash valleys for asphalt shingles. (Theory only)
7. Install asphalt composition (strip) shingles.
8. Roof styles. (Theory only)

XIV. CARPENTRY - ROOFING (cont.)

9. Install and align ridge boards.
10. Install roof sheathing.
11. Lay out, cut and install ceiling joist.
12. Lay out, cut and install common rafters for equal-pitch roofs.
13. Lay out, cut and install common rafters for unequal-pitch roofs. (Theory only)
14. Lay out a common roof plan. (Theory only)
15. Lay out, cut and install cripple jack rafters for hip and valley installations. (Theory only)
16. Lay out, cut and install gable studs. (Theory only)
17. Lay out, cut and install gambrel roof rafters.
18. Lay out, cut and install hip rafters for equal-pitch roofs. (Theory only)
19. Lay out, cut and install hip jack rafters. (Theory only)
20. Lay out, cut and install valley rafters for equal-pitch roofs. (Theory only)
21. Lay out wall plates and ridge board to receive rafters.

DUTY: BASIC AIR-CONDITIONING

TASK: Use a voltmeter, ammeter and ohmmeter.

Performance Objectives:

Given a complete air-conditioning system, and the necessary tools, the student will check the electrical circuits for satisfactory operation.

Evaluation Criterion:

The student will complete the task within a length of time considered reasonable by the instructor and will receive the instructor's approval.

Performance Guide:

1. Review the information covered in lecture.
2. Remove the motor compartment door in order to expose the wiring.
3. Sketch the wiring diagram for the following circuit:
    a. The motor control thermostat and motor compressor circuit.
    b. The condenser fan circuit.
4. Check and record the closed circuit voltage and amperage of each circuit.
5. Check the resistance of each circuit. (POWER OFF)
6. Operate the arc unit and record the following temperature:
    a. Evaporation.
    b. Condenser.
7. Replace all covers and doors.
8. Have wiring diagram checked and approved by the instructor.
9. Clean the work area and return all the materials to the proper storage.

MAINTENANCE MECHANICS

UNIT I. BASIC AIR-CONDITIONING

Tasks Covered:

1. Use a voltmeter, ammeter and ohmmeter.
2. Trace a 120V electrical circuit. (Theory only)
3. Dismantle and assemble a single-phase motor.
4. Test an open type capacitor-start electric motor.
5. Check and adjust a thermostat. (Theory only)
6. Check a current relay.
7. Check a potential relay.
8. Check a thermal relay.
9. Check a solenoid valve.
10. Make electrical connections.
11. Test a capacitor-start hermetic motor.
12. Test and operate a capacitor-start, capacitor-run (CSR) hermetic motor.
13. Replace a relay and overload protector.
14. Replace a condensor fan motor.
15. Replace an evaporator fan motor.
16. Check all electrical components of a 120V air-conditioning system.
17. Check a 120V system with a 24V control circuit.
18. Trace the circuits and draw the wiring diagram for a commercial refrigerating system.

DUTY: BASIC AIR-CONDITIONING

TASK: Trace a 120V electrical circuit. (Theory only)

Performance Objectives:

Given a lecture on a complete air-conditioning system and how to use a combination voltmeter, ammeter and ohmmeter, the student will explain how to check all the electrical wiring and components.

Evaluation Criterion:

The student will complete the task within a length of time considered reasonable by the instructor and will receive the instructor's approval.

Performance Guide:

1. Review the information covered in lecture.
2. Sketch the wiring diagram for the system showing the following circuits:
   a. The motor control thermostat and motor compressor circuit.
   b. The condenser fan circuit.
   c. The evaporator fan circuit.
3. Operate the system and record the following temperatures:
   a. The evaporator.
   b. The condenser.
4. Record the type of motor control relay used on this air-conditioning unit.
5. Record the voltage and amperage of each circuit.
6. Clean the work area and return the tools and materials to the storage area.

DUTY: BASIC AIR-CONDITIONING

TASK: Dismantle and assemble a single-phase motor.

Performance Objectives:

Given a single-phase motor and the necessary tools, the student will dismantle the motor, assemble, test it, and return it to satisfactory operating condition.

Evaluation Criterion:

The student will complete the task within a length of time considered reasonable by the instructor and will receive the instructor's approval.

Performance Guide:

1. Review the information covered in lecture.
2. Inspect the motor carefully before dismantling.
3. Run the motor and record voltage, amperage, and rpm.
4. Put a mark on end bells and stator for alignment: Remove the end bells and inspect the bearings.
5. Remove the rotor from the stator: Note the starting device mechanism.
6. Test the stator for circuit continuity and ground.
7. Test the capacitor.
8. Assemble the motor.
9. Mount the motor on the test stand to make a running test.
10. Connect the motor to the power line through a FUSED switch, and operate the motor.
11. Measure and record the voltage and current draw.
12. Clean the work area and return the tools to storage.

DUTY: BASIC AIR-CONDITIONING

TASK: Test an open type capacitor-start electric motor.

Performance Objectives:

Given an external drive capacitor-start motor and the necessary tools and instruments, the student will dismantle, check, assemble and test it.

Evaluation Criterion:

The student will complete the task within a length of time considered reasonable by the instructor and will receive the instructor's approval.

Performance Guide:

1. Review the necessary information covered in lecture.
2. Remove motor from its base; mark the position before removal. Clean motor.
3. Remove pulley from shaft using a pulley puller.
4. Test the motor for operation, grounds, shorts and open circuits.
5. Dismantle the motor:
   a. Put the matching marks on end bells and stator.
   b. Remove capacitor.
   c. Remove end bells.
   d. Remove rotor.
6. Clean and test the running winding, starting winding, capacitor, switch for grounds, shorts and open circuits.
7. Repair or replace defective parts.
8. Assemble the motor; check that bearings do not bind; correct if necessary. Oil bearings if necessary.
9. Mount motor, connect and test. Record the current and voltage readings.
10. Install the motor on base and check its operation.
11. Clean the work area and return the tools and materials to the storage.

DUTY: BASIC AIR-CONDITIONING

TASK: Check and adjust a thermostat. (Theory only)

Performance Objectives:

Given a lecture presentation on the air-conditioning system with a thermostatic control, the student will explain the correct procedures in removing, checking, installing and adjusting the thermostat to a satisfactory cycle.

Evaluation Criterion:

The student will explain in his own words the steps in the correct sequence to meet the established procedure of the job.

Performance Guide:

The recommended steps:

1. Determine if the thermostat is faulty through the use of a test light. If nonoperational, proceed with the following step.
2. Remove the motor control from the unit; be careful not to damage the power element.
3. Test the control. Determine the cut-in and cut-out temperatures by means of a temperature bath.
4. Install the control.
5. Repair or replace the control.
6. Adjust the cut-in to 25°F and the cut-out to 15°F.
7. Install the control in the unit and operate the system.

DUTY: BASIC AIR-CONDITIONING

TASK: Check a current relay.

Performance Objectives:

Given a hermetic air-conditioning system with a current relay and the proper tools and instruments, the student will check the relay for the correct operation.

Evaluation Criterion:

The student will complete the task within a length of time considered reasonable by the instructor and will receive the instructor's approval.

Performance Guide:

1. Review carefully the materials covered in lecture for the task.
2. Check the complete unit. Start the unit if possible.
3. a. If the unit WILL NOT START, disconnect the motor leads and connect the test analyzer.
   b. If the unit STARTS satisfactorily with the analyzer, then the trouble is in the external electrical circuit either in:
      - the relay
      - the capacitor
      - the thermostat
      - the wiring, or
      - the overload protector.
4. Check the overload protector with the test lamp or with ohmmeter. If it is operational, continue to Step 5.
5. a. Disconnect the relay from the circuit and substitute a good relay.
   b. Leave the old capacitor in the circuit: BE VERY CAREFUL if soldered connections are used.
   c. Label each wire removed to aid correct rewiring.

Performance Guide (cont.):

6. The replacement relay must be an exact replica (electrically) of the original. If at all possible, use a genuine replacement part.
7. Try to start the unit again. If it STARTS, the trouble was somewhere in the relay.
8. Clean the work areas and return all the materials to the storage.

DUTY: BASIC AIR-CONDITIONING

TASK: Check a potential relay.

Performance Objectives:

Given a hermetic air-conditioning system with a potential relay and the necessary tools and instruments, the student will check the relay for the correct operation.

Evaluation Criterion:

The student will complete the task within a length of time considered reasonable by the instructor and will receive the instructor's approval.

Performance Guide:

1. Check the complete unit and start it if possible.
2. a. If the unit WILL NOT START disconnect the motor leads and connect the test analyzer.
   b. If the unit STARTS with the analyzer, the problem is in the external electrical circuit and not in the motor.
3. Check the external circuit, thermostat, wiring, overload, etc.: If they check out satisfactorily, continue.
4. Remove the relay from the circuit and substitute a good relay. If the relay is bad, replace it.
5. Reassemble the unit using the new relay. Start the unit. If it is now operational, the trouble was in the relay.
6. Clean the work area and return all the materials to storage.

DUTY: BASIC AIR-CONDITIONING

TASK: Check a thermal relay.

Performance Objectives:

Given a hermetic air-conditioning system with a thermal relay and the necessary tools and instruments, the student will check the thermal relay to the approved operational efficiency.

Evaluation Criterion:

The student will complete the task within a length of time considered reasonable by the instructor and will receive the instructor's approval.

Performance Guide:

1. Review the necessary information covered in lecture.
2. Check the complete unit; start the unit if possible.
3. a. Check the other parts of the circuit: the motor, capacitor, overload cut-out and thermostat.
   b. Make sure that the proper fuse size has been used in the main circuit.
4. If all above parts check out fine, check the relay tester.
5. Check the system with the analyzer.
6. Remove the relay from circuit, and substitute a good relay of same capacity.
7. Operate the system.
8. Clean the work area and return the materials to storage.

DUTY: BASIC AIR-CONDITIONING

TASK: Check a solenoid valve.

Performance Objectives:

Given an air-conditioning system with a solenoid valve and the necessary tools and instruments, the student will check the solenoid valve for satisfactory operation.

Evaluation Criterion:

The student will complete the task within a length of time considered reasonable by the instructor and will receive the instructor's approval.

Performance Guide:

1. Review the reference materials.
2. Check the complete system; operate the solenoid if possible.
3. If the solenoid DOES NOT operate, first check the power-in, the wiring and the solenoid circuit switch.
4. If the leads and components are operational, remove the solenoid coil.
5. Test the solenoid coil for open circuit, short, and grounds.
6. If the coil is defective, replace with a good coil of the same specifications: size, voltage, watts.
7. Operate the system.
8. Clean the work area: Return all the tools and materials to their storage.

DUTY: BASIC AIR-CONDITIONING

TASK: Make electrical connections.

Performance Objectives:

Given an air-conditioning electrical circuit, wire, terminals and the necessary tools, the student will replace the wire in a satisfactory manner.

Evaluation Criterion:

The student will complete the task within a length of time considered reasonable by the instructor and will receive the instructor's approval.

Performance Guide:

1. Review the information covered in lecture.
2. Make practice connections with both stranded wire and solid wire: Remove just enough insulation to mount the terminal. Do not kick the wire or wire strands.
3. Replace all the wiring on the practice board.
4. Test all the wiring for continuity with the test light.
5. Test all the terminals, connections, and wiring with the ohmmeter.
6. Clean the work area and return all the materials to the proper storage.

DUTY: BASIC AIR-CONDITIONING

TASK: Test a capacitor-start hermetic motor.

Performance Objectives:

Given a hermetic air-conditioning system with a capacitor-start motor compressor and the necessary tools and instruments, the student will check the motor compressor for correct operation.

Evaluation Criterion:

The student will complete the task within a length of time considered reasonable by the instructor and will receive the instructor's approval.

Performance Guide:

1. Check the complete system and operate it if possible.
2. If nonoperational, shut OFF the power and remove the starting relay and overload protector from the motor compressor.
3. Test the motor for open circuit, grounds and shorts using a test light and ohmmeter.
4. Test the capacitor with capacitor tester for open circuit.
5. Connect motor test cord with a good capacitor to motor terminals; start motor compressor.
6. If operational, replace wiring and test-operate the system.
7. Clean the work area and return all the tools and supplies to the storage area.

DUTY: BASIC AIR-CONDITIONING

TASK: Test and operate a capacitor-start, capacitor-run (CSR) hermetic motor.

Performance Objectives:

Given an air-conditioning system with a hermetic capacitor-start, capacitor-run motor and the necessary tools and instruments, the student will check for proper operation.

Evaluation Criterion:

The student will complete the task within a length of time considered reasonable by the instructor and will receive the instructor's approval.

Performance Guide:

1. Review the necessary information covered in lecture.
2. Check the complete system and operate it if possible.
3. If the system WILL NOT operate, shut OFF the power and remove the starting relay, overload relay, starting capacitor, and running capacitor. Mark any wires removed to insure the correct reconnection.
4. Test the motor winding circuits for continuity, grounds, and open circuits.
5. Test the capacitors. Replace any if required.
6. Test the relay, and replace if necessary.
7. Reconnect the starter relay capacitors; test-operate the system.
8. Clean the work area and return all the tools and supplies to the storage area.

DUTY: BASIC AIR-CONDITIONING

TASK: Replace a relay and overload protector.

Performance Objectives:

Given a hermetic system with a relay and overload protector, and the necessary tools and instruments, the student will remove, test and replace the relay and overload protector.

Evaluation Criterion:

The student will complete the task within a length of time considered reasonable by the instructor and will receive the instructor's approval.

Performance Guide:

1. Review the information covered in lecture.
2. a. Disconnect the motor from the system.
   b. Short any capacitors to prevent a shock.
   c. Mark each wire to indicate its terminal before disconnecting.
3. If an analyzer is used, connect the analyzer leads to the motor terminal leads according to the directions.
   a. Test the continuity of each winding.
   b. Test for grounds and shorts.
   c. If the electrical properties are satisfactory, but the unit will not start, try using a larger capacitor, a higher voltage, or a capacitor in the running circuit to reverse the rotation. CAUTION: FOLLOW THE INSTRUCTIONS CAREFULLY.
4. If a test light and/or an ohmmeter is used:
   a. Check for continuity, shorts, and internal winding shorts.
   b. Connect a capacitor in the starting circuit and check the unit by using a manual relay.

Performance Guide (cont.):

5. a. If the motor DOES function, any electrical trouble is in the external circuit.
   b. If the overload has been operating too frequently, the current draw and the overheating of the motor should be checked.
6. Reassemble the wiring of the system and test-operate the unit.
7. Clean the work area and return all the tools and supplies to the storage area.

DUTY: BASIC AIR-CONDITIONING

TASK: Replace a condenser fan motor.

Performance Objectives:

Given an air-conditioning system with a condenser fan motor, and the necessary tools and instruments, the student will replace and check a fan motor.

Evaluation Criterion:

The student will complete the task within a length of time considered reasonable by the instructor and will receive the instructor's approval.

Performance Guide:

1. Review the materials covered in lecture.
2. Operate the system: Measure the voltage and current for the fan motor.
3. Shut OFF the system; disconnect the power source; label the terminal leads, and remove the fan and fan motor.
4. Remove the fan from the motor shaft; clean the motor; dismantle the motor if possible.
5. Check the continuity of windings and the resistance of windings.
6. Assemble motor; check bearing for radial and end play.
7. Reinstall the motor and fan in the system: POSITION PROPERLY.
8. Make the electrical connections.
9. Operate the system; check for noise, and voltage amperage readings.
10. Clean the work area and return all materials to the storage area.

DUTY: BASIC AIR-CONDITIONING

TASK: Replace an evaporator fan motor.

Performance Objectives:

Given an air-conditioning system with an evaporator fan and the necessary tools and instruments, the student will test, repair or replace the fan motor.

Evaluation Criterion:

The student will complete the task within a length of time considered reasonable by the instructor and will receive the instructor's approval.

Performance Guide:

1. Study the assigned materials for the job.
2. a. Check the complete unit.
   b. Allow the unit to operate for a few minutes.
   c. Determine if the evaporator fan motor is operating.
3. Check the fan and motor for noise or overheating.
4. Check all connections for possible loose connections.
5. Check the motor amperage and voltage.
6. SHUT OFF power; disconnect all the electric wiring, marking each wire as to its terminal.
7. Unbolt motor from the base mounting, and loosen fan on shaft.
8. Remove fan, clean and test for open circuit, shorts and grounds.
9. Install a new motor of same electrical specifications.
10. Reconnect all wires and test-operate the unit: Make sure the fan is rotating in proper direction and is in its correct position on shaft.
11. Clean up the work area and return all the tools and supplies to the storage area.

DUTY: BASIC AIR-CONDITIONING

TASK: Check all electrical components of a 120V air-conditioning system.

Performance Objectives:

Given an air-conditioning system and the necessary tools and instruments, the student will check all the wiring and electrical components.

Evaluation Criterion:

The student will complete the task within a length of time considered reasonable by the instructor and will receive the instructor's approval.

Performance Guide:

1. Review the electrical circuitry and components system.
2. Make an electrical diagram of the system and fill out the data sheet.
3. Operate the system and check the voltage and amperage.
4. a. Remove the electrical parts except motor-compressor from the system. MAKE SURE THE POWER IS DISCONNECTED.
   b. Mark each part as to its terminal or connection.
5. Check each electric part for resistance, grounds, open circuits, and shorts.
6. Assemble the electrical parts into the electrical system.
7. Operate the system. Use the instruments to check the voltage and current.
8. Clean the work area and return all the materials to the storage area.

MAINTENANCE MECHANICS: Basic Air Conditioning
Data Sheet for Electrical Components

Name:______________________________ Date:__________________

Compressor Motor:

Make:__________________ Model:_____________ rpm:________

Voltage:________ Phase:_______ Rated Current: Start:________ Run:________

Starting Capacitor:

Make:__________________ Voltage:_____________ Mfd:________

Running Capacitor:

Make:__________________ Voltage:_____________ Mfd:________

Condenser Fan Motor:

Make:__________________ Model:_____________ rpm:________

Voltage:________ Phase:_______ Rated Watts, Run:__________

Evaporator Fan Motor:

Make:__________________ Model:_____________ rpm:________

Voltage:________ Phase:_______ Rated Watts, Run:__________

Motor Control:

Make:__________________ Model:_____________ rpm:________

Capacity-Voltage:_____________ Current:__________________

Solenoid Valve:

Make:__________________ Model:_____________

Electrical Rating:__________________________

Current Checks:

Before Assembly:______________ After Assembly:____________

Voltage Checks:

Before Assembly:______________ After Assembly:____________

Condition of Electrical System:______________________________

DUTY: BASIC AIR-CONDITIONING

TASK: Check a 120V system with a 24V control circuit.

Performance Objectives:

Given a complete system powered by 120V but controlled by a 24V circuit and the necessary tools and instruments, the student will check and service both circuits to approved standards.

Evaluation Criterion:

The student will complete the task within a length of time considered reasonable by the instructor and will receive the instructor's approval.

Performance Guide:

1. Study the 120V and 24V circuits and their parts.
2. Operate the 24V system.
3. Check the voltage and current.
4. Shut off the system.
5. Remove all 24V parts: mark all lines and terminals.
6. Test each part for grounds, shorts, and open circuits.
7. Install the 24V parts.
8. Operate the system and check the voltage and current.
9. Clean up the work area and return all the material and tools to the storage area.

DUTY: BASIC AIR-CONDITIONING

TASK: Trace the circuits and draw the wiring diagram for a commercial refrigerating system.

Performance Objectives:

Given a one- to three-horsepower commercial refrigerating system for a central air-conditioning unit, the student will trace the electrical circuits and draw a wiring diagram.

Evaluation Criterion:

The student will complete the task within a length of time considered reasonable by the instructor and will receive the instructor's approval.

Performance Guide:

1. Study the electrical circuitry of the system.
2. Make an electrical diagram of the system and fill out the data sheet.
3. Operate the system. Use the instruments to check the voltage and current.

MAINTENANCE MECHANICS: Data Sheet for Commercial Refrigeration

Name: ______________________ Date: ______________

Compressor Motor:

Make: ____________ Model: __________ rpm: ________

Voltage: ______ Phase: ______ Rated Current: Start: ______ Run: ________

Starting Capacitor:

Make: ____________ Voltage: __________ Mfd: ________

Running Capacitor:

Make: ____________ Voltage: __________ Mfd: ________

Evaporator Blower Motor:

Make: ____________ Model: __________ rpm: ________

Voltage: ______ Phase: ______ Rated Current: Start: ______ Run: ________

Condenser Fan Motor:

Make: ____________ Model: __________ rpm: ________

Voltage: ______ Phase: ______ Rated Current: Start: ______ Run: ________

Motor Control:

Make: ____________ Model: __________

Capacity-Voltage: ______ Current: __________

Relay:

Make: ____________ Model: __________ Rating: ______

Overload Protectors:

Make: ____________ Model: __________ Rating: ______

Voltage Checks: ______________________________________

Percent Current Checks: ______________________________

Condition: ____

MAINTENANCE MECHANICS

UNIT II. AIR-CONDITIONING

Tasks Covered:

1. Remove, test, install and adjust a thermostatic expansion valve. (Theory only)
2. Remove, clean, install and operate an oil separator. (Theory only)
3. Remove, inspect, install and adjust a commercial type pressure motor control. (Theory only)
4. Install a remote air-cooled condenser. (Theory only)
5. Install and test a rooftop system. (Theory only)
6. Locate trouble in a water-cooled system. (Theory only)

DUTY: AIR-CONDITIONING

TASK: Remove, test, install and adjust a thermostatic expansion valve. (Theory only)

Performance Objectives:

Given an illustration of a conventional TEV system, the student will learn the correct procedure in diagnosing and adjusting it to the proper low-side pressure and temperature at the sensing element.

Evaluation Criterion:

The student will demonstrate his knowledge of the diagnosis and the adjustment of the given system to the instructor's satisfaction by explaining the correct procedures for the job.

Performance Guide:

Study the illustration of the conventional TEV system and know the following proper steps to carry out the task:

1. Install the gauge manifold.
2. Start the unit and note the low-side pressure after the unit has run 20 minutes.
3. Adjust the service valves preparatory to removing the thermostatic expansion valve.
4. Remove the thermostatic expansion valve.
5. Clean the TEV, including the screen.
6. Test the valve.
7. Connect it to an air line.
8. Put the power element in an ice and water bath.
9. Test the needle with oil against a 90-pound air pressure.
10. Adjust to an 10° F superheat setting.
11. Install TEV in system; purge and/or evacuate.
12. Build up pressure and test for leaks.
13. Start the unit; after running it for 20 minutes, record the low-side pressure and the temperature at the power element location.

DUTY: AIR-CONDITIONING

TASK: Remove, clean, install and operate an oil separator. (Theory only)

Performance Objectives:

Given an illustration of a commercial condensing unit, the student will learn the correct procedure in the removal and installation of an oil separator.

Evaluation Criterion:

The student will demonstrate his knowledge, to the instructor's satisfaction, by explaining the correct procedure in the removal and installation of an oil separator.

Performance Guide:

Study the assigned materials and know the following proper steps to carry out the task:

1. Check the unit.
2. Install the gauge manifold.
3. a. Remove the refrigerant from the system.
   b. Balance pressures.
   c. Remove the oil separator.
4. Dismantle and clean the separator.
5. Assemble the separator.
6. a. Install the separator.
   b. Test for leaks.
   c. Evacuate the system.
   d. Charge the system.
7. Run the unit for at least 20 minutes.

DUTY: AIR-CONDITIONING

TASK: Remove, inspect, install and adjust a commercial type pressure motor control. (Theory only)

Performance Objectives:

Given a commercial air-conditioning system, the student will learn the correct procedure in the removal, inspection and adjustment of a commercial type pressure motor control that will provide the desired temperature.

Evaluation Criterion:

The student will demonstrate his knowledge, to the instructor's satisfaction, by explaining the correct procedure for the job.

Performance Guide:

Study the system assigned and understand the proper steps to carry out the task:

1. Examine the control and determine the cut-in and cut-out settings.
2. Determine the safety control settings using a hydraulic pump and gauge.
3. Determine the low-side control settings using a vacuum pump with a compound gauge.
4. Adjust the cut-in and cut-out points.
5. Install the control in the system.
6. Operate the system for 20 minutes.

DUTY: AIR-CONDITIONING

TASK: Install a remote air-cooled condenser. (Theory only)

Performance Objectives:

Given a lecture on a remote air-cooled condenser, the student will learn the proper procedures in the installation, operation and test of the unit.

Evaluation Criterion:

The student will demonstrate his understanding to the instructor's satisfaction by explaining the correct procedures for the task.

Performance Guide:

Study the assigned, and know the following procedure:
1. Position the remote air-cooled condenser and the compressor unit.
2. Install the condenser line and the return line.
3. Connect the electrical devices.
4. Evacuate the system, charge with vapor refrigerant to 25 psi; test for leaks.
5. If no leaks are found, charge to 75 psi and test for leaks.
6. Use local code requirements.
7. If no leaks are found, evacuate by deep evacuation method or the three-step evacuation method.
8. Charge the system.
9. Operate the system for 10 to 20 minutes.
10. Remove the gauge manifold.
11. Shut down the system.

DUTY: AIR-CONDITIONING

TASK: Install and test a rooftop system.
(Theory only)

Performance Objectives:

Given the necessary information on a rooftop unit, the student will learn the correct procedure of the installation and operation of the system.

Evaluation Criterion:

The student will demonstrate his understanding of the proper steps to take in the installation and operation of a rooftop system to the satisfaction of the instructor.

Performance Guide:

Study the system assigned, and know the following procedure:

1. Inspect and determine the tools and supplies to install the system.
2. Know the proper position for the evaporator.
3. Know the proper position for the rooftop unit and the level of installation.
4. Connect the suction line; liquid line; and electrical service.
5. Install gauge manifold.
6. Evacuate the system.
7. If no leaks are found, charge to 25 psi and test for leaks.
8. If no leaks are found, charge to 75 psi and test for leaks.
9. Balance the pressure; remove the liquid line connections at the condensing unit install the drier and sight glass.
10. Purge the liquid line.
11. Recharge the system.
12. Operate the system for at least 15 minutes; check the pressure and temperatures.
13. Remove the gauge manifold.
14. Shut down the system.

DUTY: AIR-CONDITIONING

TASK: Locate trouble in a water-cooled system.
(Theory only)

Performance Objectives:

Given a water-cooled system, ths student will learn the proper procedure in locating and correcting the problems most frequently found.

Evaluation Criterion:

The student will demonstrate his knowledge in locating and correcting the trouble in a water-cooled system by explaining the proper steps to follow to the satisfaction of the instructor.

Performance Guide:

Study the system assigned and know the following procedure.

1. Install gauge manifold.
2. Run the system at least for 15 minutes: Record the operating pressure.
3. Check the temperature of water leaving condenser.
4. Determine proper operating pressures for the unit.
5. Check the temperature.
6. Record the suction and liquid line temperature.
7. Record water-in and water-out temperatures.
8. Check and record water-flow in gpm. (Gallons-per-minute).
9. Test the system for leaks.
10. Determine and record the cycling pressures, temperatures, and any troubles in the system.
11. Remove the gauge manifold.
12. Shut down the system.

MAINTENANCE MECHANICS

UNIT III. RESIDENTIAL AIR-CONDITIONING

Tasks Covered:

1. Add oil to a hermetic system.
2. Add refrigerant to a hermetic system.
3. Install a filter-drier.

DUTY: RESIDENTIAL AIR-CONDITIONING

TASK: Add oil to a hermetic system.

Performance Objectives:

Given a hermetic system, a supply of refrigerant oil and the necessary tools, the student will add oil to the system to the approved standards.

Evaluation Criterion:

The student will complete the task within a length of time considered reasonable by the instructor and will receive the instructor's approval.

Performance Guide:

1. Study the hermetic system assigned, and review the reference materials.
2. a. Attach the gauge manifold to the service valve adaptor or to the clamp-on service valve.
   b. Purge all the attached lines using the refrigerant cylinder.
3. Add oil in one of two methods:
   a. Evacuate the system; add oil using system vacuum and then recharge the system.
   b. Build up a refrigerant pressure in an oil cylinder higher than the system pressure and force the oil into the system.
4. Start the system; check operating pressures and temperatures.
5. Close valves and remove the gauge manifold.
6. Clean the work area and return all materials to storage.

DUTY: RESIDENTIAL AIR-CONDITIONING

TASK: Add refrigerant to a hermetic system.

Performance Objectives:

Given a hermetic system and the necessary tools and supplies, the student will charge and test the system to the acceptable standard.

Evaluation Criterion:

The student will complete the task within a length of time considered reasonable by the instructor and will receive the instructor's approval.

Performance Guide:

1. Study the hermetic system assigned.
2. a. Start the system and allow it to run for at least 15 minutes.
   b. Check for frost line in the evaporator.
   c. Check for leaks.
3. a. Install the service valve attachment or clamp-on valve on the suction line (low side).
   b. Install the gauge manifold.
4. a. Connect the refrigerant cylinder.
   b. Purge the lines, using cylinder gas.
   c. Test for leaks.
5. Charge the system:
   a. Open the valves and heat the service cylinder by placing it in a bucket of hot water.
   b. The cylinder must be upright.
   c. Keep the low-side pressures in the normal range.
6. Check the system by running the unit and by testing for leaks.
7. Remove the gauge manifold and lines. Test for leaks.
8. Clean the work area and return all the materials to the storage.

DUTY: RESIDENTIAL AIR-CONDITIONING

TASK: Install a filter-drier.

Performance Objectives:

Given a hermetic system with a clogged filter-drier, and the necessary tools, the student will replace the filter-drier and return the system to the satisfactory operation.

Evaluation Criterion:

The student will complete the task within a length of time considered reasonable by the instructor and will receive the instructor's approval.

Performance Guide:

1. a. Install valve adaptor.
   b. Connect gauge manifold.
   c. Remove refrigerant from system. VENTILATE WELL.
2. a. Clean the joints; flux the joints; heat.
   b. Remove the drier.
   c. Record the size of the fittings. HANDLE HOT PARTS WITH PLIERS.
3. a. Install the new drier in the system carefully.
   b. Flux and brace.
   c. Use the refrigerant cylinder to create a 70 to 90 psi head pressure.
   d. Test for leaks.
4. If no leaks, evacuate the system for at least an hour.
5. Charge the system and operate the system for 20 minutes. If the drier heats or gets warm, it means it is absorbing moisture.
6. a. Remove the gauge manifold from the system. BE CAREFUL.
   b. Test the system for leaks again.
7. Clean up the work area and return all materials to the storage.

MAINTENANCE MECHANICS

UNIT IV. AIR-CONDITIONING

Tasks Covered:

1. Measure relative humidity and dew point. (Theory only)
2. Measure air velocity in a duct using an anemometer. (Theory only)
3. Install and use a water manometer. (Theory only)
4. Measure air velocity in a duct using a pitot tube. (Theory only)
5. Measure air velocity in a duct using a velocimeter. (Theory only)
6. Measure pressure drop through a filter. (Theory only)
7. Install and operate airflow control. (Theory only)
8. Install a window type comfort cooler.
9. Install a residential central cooling system. (Theory only)
10. Install a rooftop comfort cooling system. (Theory only)
11. Install a heat pump. (Theory only)
12. Locate trouble in a window type comfort cooler.
13. Locate trouble in a heat pump. (Theory only)
14. Locate trouble in a residential central comfort cooling system. (Theory only)
15. Locate troubles in a water chiller. (Theory only)

DUTY: AIR-CONDITIONING

TASK: Measure relative humidity and dew point. (Theory Only)

Performance Objectives:

Given a study unit on a wet bulb and a dry bulb thermometer, the student will understand how to obtain a 100% accurate dew point reading, both indoor and outdoor.

Evaluation Criterion:

The student will explain, to the instructor's satisfaction, how to obtain a correct dew point reading.

Performance Guide:

Study the construction and operation of the sling psychrometer and the instruments, and the methods used to measure dew point, and know the following proper steps:

1. Take an indoor and outdoor relative humidity measurement:
   a. Wet wicks with distilled water.
   b. Swing the sling psychrometer, chest high, several times.
   c. Record the readings.
   d. Repeat until 5 readings are recorded. (At least the last two readings must be the same to insure correct readings.)
   e. Record the readings of the wall psychrometer.
   f. Determine the other 6 values for the air from the psychrometric chart.
2. Take an indoor and outdoor dew point measurement:
   a. Clean the dew point apparatus thoroughly.
   b. Connect the pump to the inlet of the dew point apparatus.
   c. Fill well one-half full of ether. DANGER: ETHER IS EXPLOSIVE. Ventilate well. NO OPEN FLAMES OR SPARKS NEAR THE UNIT.

DUTY: AIR-CONDITIONING

TASK: Measure relative humidity and dew point - page 2

Performance Guide (cont.):

2. d. Mount thermometers: Suspend one thermometer inside thermometer well extending into the ether; mount the other thermometer in special bracket built on dew point apparatus.
   e. Obtain readings: The slower the ether temperature lowers, the more accurate the results.
      (1) Work pump gently, forcing air slowly through the ether.
      (2) Watch the glass window.
      (3) As soon as the mist appears, read the thermometer suspended in the ether.
      (4) Warm the unit.
      (5) When the fog or mist disappears, read the readings.

DUTY: AIR-CONDITIONING

TASK: Measure air velocity in a duct using an anemometer. (Theory Only)

Performance Objectives:

Given the study unit on a fan and duct system, the student will know how to determine the correct air velocity in the duct.

Evaluation Criterion:

The student will explain, to the instructor's satisfaction, how to determine the correct air velocity in the duct.

Performance Guide:

Study the type of the anemometer to be used and know the following steps:

1. Obtain the air velocities at one outlet grille and one inlet grille:
    a. Hold the anemometer in the correct position.
    b. Allow the anemometer fan to reach a constant speed.
    c. Start the anemometer readings and the stop watch at the same time.
    d. For high velocities, measure in 1/2-minute intervals. For low velocities, measure in 1-minute intervals.
2. Measure dry bulb and wet bulb temperatures at inlet and outlet openings.
3. Calculate air volume and air weight passing through openings.

DUTY: AIR-CONDITIONING

TASK: Install and use a water manometer.
(Theory Only)

Performance Objectives:

Given a study unit on a multiple duct system and a water manometer, the student will learn to determine the velocity, pressures, and flow of air through the inlets and outlets and ducts.

Evaluation Criterion:

The student will explain, to the instructor's satisfaction, how to determine the velocity, pressures and flow of air through the inlets and outlets and ducts using a water manometer.

Performance Guide:

Study the multiple duct system assigned and know the following steps:

1. Check the grilles and duct work for obstructions.
2. Obtain the air velocities at all outlet grilles and inlet grille, using an anemometer: Record data and measure the size of the grille.
3. Measure the dry bulb and wet bulb temperatures at the inlet and outlets; calculate the air volume and air weight passing through each opening.
4. Install manometer to obtain duct pressure in inlet duct and in each of the three outlet ducts. Record data.

DUTY: AIR-CONDITIONING

TASK: Measure air velocity in a duct using a pitot tube. (Theory Only)

Performance Objectives:

Given a study unit on an air-conditioning duct system and a pitot tube, the student will learn to determine the velocity of air through the system.

Evaluation Criterion:

The student will explain, to the satisfaction of the instructor, how to determine the velocity using a pitot tube.

Performance Guide:

Study the pitot tube system designated for the job, and know the following steps:

1. Start the unit and record the data.
2. Using a pitot tube, take 10 to 20 readings at both the inlet and outlet grilles.
3. Measure the wet bulb and dry bulb readings at both openings.
4. Calculate the air weights for both the inlet and outlet openings.

DUTY: AIR-CONDITIONING

TASK: Measure air velocity in a duct using a velocimeter. (Theory Only)

Performance Objectives:

Given a unit on how to use a velocimeter, the student will learn to determine the velocity of air in a duct.

Evaluation Criterion:

The student will explain, to the satisfaction of the instructor, how to determine the velocity in a duct using a velocimeter.

Performance Guide:

Study the velocimeter and know the following steps.

1. Record the velocimeter data: Be sure to use the correct air pick up jet.
2. Determine the average velocity of one outlet opening: Take 16 to 20 readings using the standard sectioning plan.
3. Determine the average velocity at the inlet opening: Take 16 to 20 readings.

DUTY: AIR-CONDITIONING

TASK: Measure pressure drop through a filter. (Theory Only)

Performance Objectives:

Given a study unit on a standard forced air system, the student will learn to determine the pressure drop caused by an air filter.

Evaluation Criterion:

The student will explain, to the instructor's satisfaction, how to determine the pressure drop caused by an air filter.

Performance Guide:

Study the fan and filter system designated, and know the following steps:

1. a. Locate or make holes for manometer tubes and connect manometer.
   b. Record the original setting or reading.
2. Record readings of manometer after the unit has started. Pressure drop is the difference between the two liquid levels.
3. Install differential manometer across the filter.
4. Operate the fan system: Measure the pressure drop across the filter.
5. Stop the system; remove the filter, operate the system; and take the readings.
6. Stop the system; install a new filter; operate the system; and take the readings.
7. Reduce the fan system intake-opening to half size: Operate the system and take the readings.
8. Take manometer readings on both sides of the filter.
9. Plug instrument openings in duct.

DUTY: AIR-CONDITIONING

TASK: Install and operate airflow control.
(Theory Only)

Performance Objectives:

Given a lecture on a forced air furnace, the student will learn to determine if the airflow control devices used on the system are properly functioning, and know how to balance the airflow.

Evaluation Criterion:

The student will explain, to the instructor's satisfaction, how to determine the proper functioning of the airflow control and how to balance the airflow.

Performance Guide:

Study the total system and know the following steps in determining the type and purposes of the airflow control:

1. Measure the duct size.
2. Determine the type of airflow control, damper control, or the fire damper used, and its size.
3. Operate the system, measure the air velocities, and calculate the air volumes and temperatures.
4. Have the instructor assign the air volumes desired at each opening.
5. Operate the system and adjust the damper controls or airflow controls to the desired volumes.

DUTY: AIR-CONDITIONING

TASK: Install a window type comfort cooler.

Performance Objectives:

Given a window type comfort cooler, the student will install, seal properly, and provide for a proper condensate drainage.

Evaluation Criterion:

The student will complete the task within a length of time considered reasonable by the instructor, and receive the instructor's approval.

Performance Guide:

1. Study the window unit and window frame assigned.
2. Take the unit out of the crate. Check for damage.
3. Check voltage for the unit.
4. a. Open the window; locate the center of the window.
   b. Position the unit base in place.
   c. Level base and mark screw holes. Drill screw marks.
   d. Install rubber gasket on window sill.
   e. Fasten mounting base to window sill. Rustproof screws should be used.
   f. Adjust leveling screws.
5. Prepare the comfort cooler for operation: Loosen hold-down bolts. Inspect the unit for condition.
6. a. Mount unit on base; fasten unit to base.
   b. Install spacers between each side of unit and window frame: Use sealers to fill small cracks.
   c. Install the rubber gasket along the unit top.
   d. Install gasket between inner and outer double hung window.
   e. Install double hung sash lock.
7. Inspect for openings in the installation's partitions. Seal small cracks with sealing compound.
8. Operate the unit; check damper adjustments; check for noise.
9. Clean up the area and return all the tools and supplies to the storage area.

DUTY: AIR-CONDITIONING

TASK: Install a residential central cooling system. (Theory Only)

Performance Objectives:

Given a lecture presentation on a residential central cooling system, the student will learn how to install and adjust the unit to proper operating temperatures.

Evaluation Criterion:

The student will explain, to the satisfaction of the instructor, the proper method of installation and adjustment of residential central air conditioner.

Performance Guide:

Study the residential central cooling system, and know the following steps:

1. Install the condensing unit on support platform.
2. Install the evaporator in furnace plenum chamber. (New duct section may be needed.)
3. Install condensate drain or pump.
4. Install suction and liquid lines.
5. Install thermostat.
6. Install electrical wiring for motor compressor and duct fan.
7. Install gauge manifold.
8. Operate system: Check operating pressures, temperatures, and test for leaks.

DUTY: AIR-CONDITIONING

TASK: Install a rooftop comfort cooling system.
(Theory Only)

Performance Objectives:

Given a study unit on a rooftop comfort cooling system, the student will learn the proper procedure of its installation.

Evaluation Criterion:

The student will explain, to the satisfaction of the instructor, the proper procedure.

Performance Guide:

Study the system and the manufacturer's manuals, and know the correct steps to follow:

1. Position the system on the roof rails.
2. Install the electrical power and control circuits according to the instruction.
3. Test the following:
    - a. electrical circuit;
    - b. main power supply;
    - c. capacitor;
    - d. relay;
    - e. overload protector;
    - f. motor compressor;
    - g. control circuits;
    - h. filters;
    - i. air flow;
    - j. heating unit;
    - k. condensate drain;
    - l. fresh air supply;
    - m. thermostat.
4. Install gauges; check pressure and test for leaks.
5. Operate the system for at least 15 minutes: check TEV (thermostatic expansion valve) operation, condenser and evaporator conditions, fans and motor temperatures.
6. Repair or replace the necessary parts.

DUTY: AIR-CONDITIONING

TASK: Install a heat pump. (Theory Only)

Performance Objectives:

Given a lecture presentation on a heat pump unit, the student will understand the proper procedures of its installation and operation.

Evaluation Criterion:

The student will explain, to the instructor's satisfaction, the correct procedures for the task.

Performance Guide:

Study the complete heat pump system and necessary materials, and know the proper steps to follow:

1. Install the unit in accordance with the manufacturer's recommendations.
2. Install the gauge manifold.
3. Operate the system.
4. a. Determine the air conditions: both volumes and properties.
   b. Measure the air openings and the air velocities.
   c. Determine the dry bulb and wet bulb values on the inlet and outlet of both the evaporator and condenser. Record.
5. Reverse the cycle and determine the new conditions after the unit has stabilized. Record.

DUTY: AIR-CONDITIONING

TASK: Locate trouble in a window type comfort cooler.

Performance Objectives:

Given a window type comfort cooler, the student will locate and repair any troubles to the proper operation.

Evaluation Criterion:

The student will locate and repair any troubles in a window type comfort cooler to the acceptable operating standard within a length of time considered reasonable by the instructor.

Performance Guide:

1. Study the window air-conditioner assigned and its manual.
2. Test the external circuit: power in; thermostat; relay; capacitors; overload protectors; motor compressor; filters; air flow, etc.
3. Install gauges and test for leaks.
4. Run the unit for at least 15 minutes. Oil fan motors.
5. If the unit is frosting or sweating down the suction line, the system may be overcharged.
6. If the evaporator is starved, the screen or drier may be partially clogged with moisture or dirt or the unit is undercharged.
7. Repair what is necessary:
    a. Remove the refrigerant. BE CAREFUL!
    b. Replace the worn part.
    c. Assemble the unit.
    d. Evacuate the air; charge; test for leaks.
8. Remove the gauge manifold and valve adaptor.
9. Clean-up work area and return the tools and supplies to the storage area.

DUTY: AIR-CONDITIONING

TASK: Locate trouble in a heat pump. (Theory Only)

Performance Objectives:

Given a study unit on a residential heat pump system, the student will learn how to locate and repair the troubles and obtain the proper operating temperatures.

Evaluation Criterion:

The student will explain, to the instructor's satisfaction, the correct procedures in locating and repairing any troubles in a residential heat pump system.

Performance Guide:

Study the necessary materials and know the following steps:

1. a. Test external circuit first.
   b. Check power in thermostat, compressor motor, auxiliary electric heaters, solenoid valve, and four-way valve.
   c. Check for the temperature difference across the coils and airflow through the coils.
2. Install gauges; check pressures; test for leaks.
3. a. Run the unit for at least 20 minutes.
   b. Check the reversing valve and TEV (thermostatic expansion valve) operations.
   c. Check outdoor and indoor coil, fans, motors, and temperatures.
4. Check reversing valve to see if it is acting slowly or not at all.
5. Repair what is necessary:
   a. Pump all refrigerant into the liquid receiver.
   b. Replace all defective parts.
   c. Assemble the unit.
   d. Evacuate the system; charge; test for leaks.

DUTY: AIR-CONDITIONING

TASK: Locate trouble in a residential central comfort cooling system. (Theory Only)

Performance Objectives:

Given a study unit on a residential central air-conditioning system and the description of the malfunctioning found in the system, the student will learn the correct procedures for the diagnosis, repair and proper operation of the unit.

Evaluation Criterion:

The student will explain, to the instructor's satisfaction, the proper steps in diagnosis, repair and proper operation of a residential central comfort cooling system.

Performance Guide:

Study the central air-conditioning system designated and know the proper steps to follow for the task:

1. Test external circuit first: power in, thermostat; relay; capacitor; overload protector; motor compressor; filter; air flow; condensate drain; fresh air supply and condenser cooling medium.
2. Install gauges; check pressures; test for leaks.
3. Oil fan motors.
4. Run the unit for at least 15 minutes.
5. Check the TEV (thermostatic expansion valve) operation, condenser condition, fans and motors, and temperatures.
6. If the evaporator is frosting:
    a. The TEV may be leaking;
    b. The thermostat is not shutting off;
    c. The TEV bulb is loose.
7. If the evaporator is starved:
    a. The valve may be partially clogged with moisture or dirt;
    b. There may be a lack of refrigerant.

DUTY: AIR-CONDITIONING

TASK: Locate trouble in a residential central comfort cooling system. (Theory Only) - page 2

Performance Guide (cont.):

8. Repair what is necessary:
   a. Remove the refrigerant from the part to be repaired. BE CAREFUL!
   b. Replace the worn part and assemble the unit.
   c. Evacuate the air; charge; test for leaks.
9. Remove the gauge manifold.

DUTY: AIR-CONDITIONING

TASK: Locate troubles in a water chiller.
(Theory Only)

Performance Objectives:

Given a study unit on a water chiller, the student will learn how to locate and repair the troubles and return the water chiller to its proper operation.

Evaluation Criterion:

The student will explain, to the instructor's satisfaction, the correct procedures in locating and repairing a water chiller.

Performance Guide:

Study the given water chiller system, and know the following steps:

1. a. Install the gauge manifold.
   b. Run the system for at least 15 minutes.
   c. Record the pressures and temperature readings.
2. a. Check the inlet and outlet condenser water temperatures volume.
   b. Inspect the water circulation pump.
3. a. Check the high-side pressure, low-side pressure, and oil pressure.
   b. Add refrigerant or purge if necessary.
   c. Test for leaks.
4. Check the inlet and outlet temperatures of the chill water.
5. Remove the gauge manifold.

MAINTENANCE MECHANICS

UNIT V. HEATING

Tasks Covered:

1. Install and operate an atmospheric gas burner with pilot light. (Theory only)
2. Install and operate a blower type gas burner with electric ignition. (Theory only)
3. Install and operate a gun type oil burner. (Theory only)
4. Check and connect a heating thermostat.
5. Check and connect a combination thermostat.
6. Remove, clean and replace an oil burner nozzle. (Theory only)
7. Remove, test and replace an oil burner motor. (Theory only)
8. Remove, test and install an oil burner primary control. (Theory only)
9. Remove, test and install an oil burner safety control. (Theory only)
10. Install a power humidifier in a duct system. (Theory only)
11. Balance airflow in forced air system. (Theory only)
12. Replace a pump on a hydronic system. (Theory only)
13. Install and operate an electric heating system. (Theory only)
14. Locate trouble in a gas burner system.
15. Make a stack flue gas analysis. (Theory only)
16. Operate and test a baseboard electric resistance heating system.

DUTY: HEATING

TASK: Install and operate an atmospheric gas burner with pilot light. (Theory Only)

Performance Objectives:

Given a study unit on an atmospheric gas burner warm air furnace, the student will understand how to start, operate and adjust the unit.

Evaluation Criterion:

The student will explain the correct procedures for the task to the instructor's satisfaction.

Performance Guide:

Study the designated gas burner and know the proper steps to follow:

1. a. Clean the pilot light.
   b. Open the main gas valve and light the pilot light.
2. a. Test for leaks with soap suds; then operate the system.
   b. Test the thermostat to above ambient temperature.
3. Check the gas pressure, the stack draft, and temperature.
4. Check the gas flame for size and color. Adjust the primary air.
5. Check the bonnet temperature controls.
6. Shut the main gas valve and shut down the furnace.

DUTY: HEATING

TASK: Install and operate a blower type gas burner with electric ignition. (Theory Only)

Performance Objectives:

Given a study unit on a blower type gas burner with an electric ignition, the student will understand how to operate the system and adjust the burner.

Evaluation Criterion:

The student will explain the correct procedures for the task to the instructor's satisfaction.

Performance Guide:

Study the assigned materials on the designated system and know the proper steps to follow:

1. Clean the pilot light; open the main gas line.
2. Test all lines for leaks with soap suds.
3. Set thermostat to above ambient temperature.
4. Sketch the electric ignition circuit.
5. Check the gas pressure and the stack draft temperature.
6. Check the gas flame for height and color. Adjust the primary air.
7. Check bonnet temperature controls.
8. Reset thermostat and repeat check procedures (#5 - #7).
9. Shut off the main gas valve, thermostat and shut down the furnace.

DUTY: HEATING

TASK: Install and operate a gun type oil burner. (Theory Only)

Performance Objectives:

Given a lecture presentation on a furnace designed for use with an oil burner, the student will understand how to install the oil burner and operate the furnace.

Evaluation Criterion:

The student will explain the correct procedures for the task to the instructor's satisfaction.

Performance Guide:

Study the oil burner system and know the proper steps to follow:

1. Install oil burner per manufacturer's recommendations.
2. Install the oil pressure gauge on the fuel pump.
3. Install the stack thermometer.
4. Inspect the refractory firepot: If there is oil in the firepot, DO NOT start the unit.
5. Check to determine that the ignition system is operating.
6. Connect to the fuel tank; check for leaks; start the unit.
7. Check the flame color, the stack temperature, and the firepot draft.
8. Make a carbon dioxide analysis.
9. Operate for five minutes and record pressures and temperatures.
10. Check the bonnet temperature controls.
11. Shut off the system.

DUTY: HEATING

TASK: Check and connect a heating thermostat.

Performance Objectives:

Given a mock-up panel board of a 24V control system, the student will draw the wiring diagram, check and connect a heating thermostat properly, and be able to obtain desired heating temperature range.

Evaluation Criterion:

The student will complete the task to the acceptable standards within a length of time considered reasonable by the instructor.

Performance Guide:

1. Study the low voltage panel board system assigned.
2. a. Check the 24V circuit and test the parts using 24V.
   b. Make an electrical wiring diagram.
3. a. Remove all wiring.
   b. Remove all control devices.
   c. Dismantle the control devices. Study their design, construction and operation.
4. Reinstall the control devices, install the wiring, and test the circuits.
5. Operate the system.
6. Clean up the work area and return all the tools to the storage area.

DUTY: HEATING

TASK: Check and connect a combination thermostat.

Performance Objectives:

Given a mock-up panel board of a 24V to 30V combination heating and cooling thermostat, the student will determine the type, the wiring and the repair or the replacement needed.

Evaluation Criterion:

The student will complete the task to the acceptable standards within a length of time considered reasonable by the instructor.

Performance Guide:

1. Study the panel mock-up.
2. a. Check the 24V electrical circuit.
   b. Test the parts.
   c. Make an electrical wiring diagram.
3. Manually turn the switch on and off. Check the system cycle.
4. a. Place the thermometer next to the thermostat.
   b. Observe the cut-in and cut-out of the thermostat.
   c. Adjust the range as needed.
5. a. Remove all wiring.
   b. Remove the control devices.
   c. Dismantle the control devices and study their design, construction and operation.
6. Reinstall the control devices; install the wiring and test the circuits.
7. Operate the system.
8. Clean up the work area and return the tools to the storage area.

DUTY: HEATING

TASK: Remove, clean and replace an oil burner nozzle. (Theory Only)

Performance Objectives:

Given a lecture presentation on a furnace with an oil burner, the student will understand how to remove the burner nozzle, clean, replace and operate the burner.

Evaluation Criterion:

The student will explain the proper procedures for the task to the instructor's satisfaction.

Performance Guide:

Study the designated oil burner system, and know the correct steps to follow:

1. Open the electrical circuit and shut off the fuel oil line.
2. a. Remove the oil burner from the furnace.
   b. Remove the nozzle using two wrenches.
   c. If the electrodes are moved, before removing, measure the electrode gap, the distance from the nozzle and the distance above the nozzle orifice.
3. Clean the nozzle and inspect the screen and orifice.
4. Replace the gun burner in the furnace.
5. Position the electrode ends carefully.
6. Replace the gun burner in the furnace.
7. Install the pressure gauge in the gauge opening at the oil pump.
8. Operate the burner for at least 10 minutes.
9. Adjust the oil pressure to the recommended pressure for the burner (Most burners operate at above 90 psi).
10. Adjust the air inlet to give the correct flame color.
11. Check the bonnet temperature control.
12. Open the switch and shut down the burner.
13. Remove the pressure gauge and replace the plug in the gauge opening.

DUTY: HEATING

TASK: Remove, test and replace an oil burner motor. (Theory Only)

Performance Objectives:

Given a lecture presentation on a hot air furnace, the student will understand how to remove the oil burner motor and check and install a new replacement motor if necessary.

Evaluation Criterion:

The student will explain the correct procedures for the task to the instructor's satisfaction.

Performance Guide:

Study the assigned materials and know the proper steps to follow for the task:

1. Disconnect the electrical power and LOCK IN "OFF" POSITION.
2. Disconnect the motor leads in the terminal box.
3. a. Disconnect the conduit fitting at the terminal box.
   b. Disconnect the motor wires.
4. Carefully remove the motor. Some models require removal of oil pump coupling and fan before the motor can be completely removed.
5. a. Free run test the replacement motor.
   b. Check voltage current draw and direction of rotation.
6. Install the motor. On some models, the fan and coupling are installed before the motor can be mounted. They must be carefully located on the motor shaft to allow end play of motor rotor after complete installation. Tighten cap screws evenly.
7. a. Connect wiring; tighten connections.
   b. Use ohmmeter to check for the continuity.
8. Operate the oil burner for 5 to 10 minutes.

DUTY: HEATING

TASK: Remove, test and install an oil burner primary control. (Theory Only)

Performance Objectives:

Given a lecture presentation on a hot air oil furnace, the student will understand how to replace the oil burner primary control by disconnecting the inoperative one, testing and installing a new one.

Evaluation Criterion:

The student will explain the correct procedures for the task to the instructor's satisfaction.

Performance Guide:

Study the primary control of the designated heating system and know the following steps:

1. Remove the primary control cover.
2. a. Shut off the electrical power.
   b. Disconnect the wires in primary control and remove the primary control. Mark the color code of the wires to identify wires.
3. Install new primary control and connect wires.
4. Check the connection with ohmmeter.
5. Turn on electrical power; check the power to primary control by test light.
6. a. Close the fuel oil line.
   b. Disconnect ignition transformer primary wire.
7. a. Close thermostat circuit.
   b. Operate the unit without ignition.
   c. Check the time required for the unit to shut off.
8. Install the stack thermometer.
9. REMOVE ANY OIL FROM THE FIREPOT! Open fuel oil valve. Connect transformer wire.
10. Turn on fuel and operate unit for 5 to 10 minutes.

DUTY: HEATING

TASK: Remove, test and install an oil burner safety control. (Theory Only)

Performance Objectives:

Given a lecture presentation on a gun type oil furnace, the student will understand how to check, repair and install the oil burner safety control.

Evaluation Criterion:

The student will explain the correct procedures for the task to the instructor's satisfaction.

Performance Guide:

Study and know the following steps for the task:

1. Inspect the refractory oilpot. If there is any oil in the firepot, do not start the unit until all oil is removed.
2. Install the pressure gauge and stack thermometer.
3. Check ignition system if it is operating.
4. Connect a small fuel oil container to the pump; check for leaks and start.
5. Check the flame color, stack temperature, and firepot draft.
6. Make the carbon dioxide analysis.
7. Operate the unit for at least 5 minutes and record pressures and temperatures.
8. a. Open ignition control system.
   b. Connect the test instrument to the safety limit control.
9. Check the circuit of control without the presence of oil.
10. a. Allow oil to spray into the combustion chamber.
    b. The safety limit control circuit must shut off the flow of oil after about 12 seconds.
    c. Remove oil.
11. Draw a schematic wiring diagram of safety limit control.

DUTY: HEATING

TASK: Install a power humidifier in a duct system. (Theory Only)

Performance Objectives:

Given a lecture presentation on a duct type hot air heating system, the student will understand how to install a power humidifier, install a humidistat, and adjust the humidifier to give correct operation.

Evaluation Criterion:

The student will explain the correct procedures for the task to the instructor's satisfaction.

Performance Guide:

Study the power humidifier and the hot air system and know the following steps for the task:

1. Select the place on the duct for mounting the power humidifier.
2. Lay out the opening to be cut in the duct.
3. Drill and cut the duct opening. Remove sharp metal edges by filing.
4. Locate the mounting holes. Drill holes; remove chips.
5. Mount the humidifier and level it.
6. Install the water line. Carefully pierce the water supply line and test for leaks.
7. Install the drain line to the nearest drain. The line must slope down at all times.
8. a. Connect the solenoid valve to the furnace electrical supply.
   b. Mount the humidistat.
9. Open the water valve. Adjust the humidistat to desired setting.
10. Operate the system.
11. Check the unit for leaks.

DUTY: HEATING

TASK: Balance airflow in forced air system.
(Theory Only)

Performance Objectives:

Given a lecture presentation on a forced hot air system, the student will understand how to measure and balance the airflow to obtain correct conditions.

Evaluation Criterion:

The student will explain the proper procedures for the task to the instructor's satisfaction.

Performance Guide:

Study the duct-system and know the following procedures for the task:

1. Measure and calculate all duct cross-sectional areas.
2. Place a thermometer in each room.
3. a. Operate the system.
   b. Measure the air velocities and calculate the air volumes at each outlet grille.
   c. Record the thermometer readings.
4. Operate the system and adjust the duct dampers until the desired outlet volumes and temperatures are obtained.

DUTY: HEATING

TASK: Replace a pump on a hydronic system.
(Theory Only)

Performance Objectives:

Given a lecture presentation on a forced circulation hydronic heating system, the student will understand the correct procedures in removing a faulty pump and installing a replacement.

Evaluation Criterion:

The student will explain the proper steps for the task to the instructor's satisfaction.

Performance Guide:

Study the forced circulation hot water heating system and know the following steps:

1. a. Close the water shut-off valves on each side of the pump.
   b. Prepare a drain pan for the water in the pump part of the system.
2. Loosen the flange bolts. Carefully remove the bolts while supporting the motor and pump; remove the motor pump.
3. Clean the gasket surfaces; insert new gaskets; carefully install the replacement motor pump.
4. Align the pump flanges, while inserting the assembly bolts. Tighten the flanges bolts evenly.
5. Open hand shut-off valves; connect electrical leads and operate the system. (Check for water leaks at the joints and seals.)

DUTY: HEATING

TASK: Install and operate an electric heating system. (Theory Only)

Performance Objectives:

Given a lecture presentation, the student will understand how to check, adjust and operate a conventional forced air electric heating system.

Evaluation Criterion:

The student will explain the correct procedures for the task to the instructor's satisfaction.

Performance Guide:

Study the system assigned and know the following steps:

1. Install the unit; make sure it is level.
2. Install the power circuit.
3. Make the proper electrical connections per system wiring diagram.
4. Install the thermostat wiring.
5. Test all the connections and circuits with an ohmmeter.
6. Test the power-in with the test light.
7. Install the duct connectors.
8. Start the system; take the electrical readings.
9. Allow the unit to operate at least one cycle.
10. Check the inlet air and outlet air temperatures. Check airflow.

DUTY: HEATING

TASK: Locate trouble in a gas burner system.

Performance Objectives:

Given a hot air furnace with gas burner, the student will locate the trouble in the system.

Evaluation Criterion:

The student will locate the trouble in a gas burner system within a length of time considered reasonable by the instructor.

Performance Guide:

1. Study the gas burner system assigned.
2. Install the gas pressure manometer.
3. Turn on the gas supply. Test for leaks with soapsuds.
4. a. Inspect the pilot light; clean it.
   b. Adjust the safety device spacing and light the pilot.
   c. IF THERE IS A GAS ODOR, PURGE FURNACE BEFORE LIGHTING.
5. Test the electrical parts and circuits.
6. a. Adjust the thermostat until the furnace starts.
   b. Inspect the flame color and shape.
   c. Adjust the primary air to obtain correct flame color.
7. Repair or replace any faulty part.
8. Record the fuel consumption. Take at least 3 gas meter readings.
9. Shut down the furnace.
10. Clean the work area and return the tools to the storage area.

DUTY: HEATING

TASK: Make a stack flue gas analysis.
(Theory Only.)

Performance Objectives:

Given a lecture presentation on an oil or gas furnace, the student will understand how to determine the efficiency of the furnace through the use of instruments.

Evaluation Criterion:

The student will explain the correct procedures for the task to the instructor's satisfaction.

Performance Guide:

Study the given materials and know the following steps for the job:

1. Turn on the gas or oil supply; test for leaks with soapsuds.
2. Inspect the pilot light system.
3. Inspect flue and stack.
4. a. Set thermostat.
   b. Start the system and inspect the flame.
   c. Adjust primary air to obtain correct flame color.
5. Install instruments; obtain the combustion draft, the stack temperature, the carbon dioxide analysis, and the smoke test.
6. Make adjustments to obtain normal values.
7. Take new readings.
8. Shut down the system.

DUTY: HEATING

TASK: Operate and test a baseboard electric resistance heating system.

Performance Objectives:

Given a baseboard electric resistance heating system, the student will test and operate the system.

Evaluation Criterion:

The student will complete the task to the acceptable standards within a length of time considered reasonable by the instructor.

Performance Guide:

1. Study the system assigned.
2. Turn on the thermostat on each heater equipped with one.
3. Determine the current required by each resistance unit.
4. Turn on the thermostat for areas controlled by thermostatically-operated relay.
5. Check the current flow.
6. Adjust the thermostat in one room to give the desired room temperature.
7. Record the current flow. Calculate the BTU's produced from the wattage.
8. Shut down the system.
9. Clean up the work area and return the tools to the storage area.

MAINTENANCE MECHANICS

UNIT VI. PLUMBING - JOINING PIPE

Tasks Covered:

1. Join cast-iron soil pipe, using lead and oakum.
2. Cut steel pipe with one-wheel cutter.
3. Join copper tubing/pipe to plastic pipe.
4. Using sweat method, join copper tubing/pipe to plastic pipe.
5. Join copper tubing to steel pipe.
6. Join plastic pipe, using solvent cement method.
7. Join plastic pipe to steel pipe.
8. Thread steel pipe with nonadjustable die.
9. Replace a section of galvanized water supply line.
10. Repair leaky water faucets or valves.

DUTY: MAINTENANCE PLUMBING - JOINING PIPE

TASK: Join cast-iron soil pipe, using lead and oakum.

Performance Objectives:

Given two 5' lengths of 4" diameter bell and spigot cast-iron soil pipe in a horizontal position, necessary tools and supplies and instructions, the student will join the two sections of the soil pipe using lead and oakum.

Evaluation Criterion:

The student will join the cast-iron soil pipe in a horizontal position to the satisfaction of the instructor.

The joint must be firmly packed with oakum and filled with molten lead not less than 1" deep and not to extend more than 1/8" below the rim of the hub. The lead must be caulked tight.

Performance Guide:

1. Light the melting furnace and heat the lead.
2. Inspect the bell and spigot ends to be caulked for moisture. Use dry rag to remove moisture.
3. Place the spigot end of the pipe into the bell of the other pipe.
4. Align the pipe so that an equal space between the pipe and hub is maintained around the circumference of the joint.
5. Yarn oakum into the hub with a yarning iron; then use packing iron and ball peen hammer to pack oakum tight.
6. Skum slag from the molten lead.
7. Clamp the joint runner around the pipe.
8. Dip a ladleful of molten lead from the melting pot and pour the lead into the joint runner.
9. Allow the lead to cool and remove the joint runner.
10. Remove the excess lead with cold chisel.
11. Using an inside caulking iron and ball peen hammer, caulk the lead around the pipe.
12. Using an outside caulking iron and ball peen hammer, caulk the lead around the inside hub wall.
13. Have the instructor check your joint.

DUTY: MAINTENANCE PLUMBING - JOINING PIPE

TASK: Cut steel pipe with one-wheel cutter.

Performance Objectives:

Given a one-wheel steel pipe cutter and a vise, the student will cut 3" from a 2' length of 3/4" diameter steel pipe.

Evaluation Criterion:

The student will cut a steel pipe with one-wheel cutter to the tolerance of ±1/16"; the cut ends must be free of burrs.

Performance Guide:

1. Secure the pipe in vise, leaving about 6" of the end to be cut protruding from the vise.
2. Measure and mark the length to be cut.
3. Place the pipe cutting wheel on the mark to be cut.
4. Tighten the cutting wheel on the pipe.
5. Make one complete revolution with the pipe cutter.
6. Tighten the cutting wheel, making 1/4 turn with the adjustment handle or knob.
7. Continue to revolve and tighten cutting wheel until the cut is completed.
8. Ream the cut ends.
9. Have the instructor check your cut.

DUTY: MAINTENANCE PLUMBING - JOINING PIPE

TASK: Join copper tubing/pipe to plastic pipe.

Performance Objectives:

Given a 1' length of 1" diameter copper tubing, a 1' length of 1" diameter plastic pipe, a copper-plastic adapter and necessary tools and materials, the student will join the sections, forming a watertight seal as evidenced by a leak test.

Evaluation Criterion:

The student will join copper tubing to a plastic pipe to the satisfaction of the instructor.

Performance Guide:

1. Position the plastic pipe on a flat surface and cut square with hacksaw.
2. Ream the plastic pipe end, inside and out, with knife.
3. Clean the exterior pipe end (1 1/2" to 2") and the inside of the female adapter with cleaner.
4. Apply cement to the cleaned pipe end.
5. Insert the plastic pipe into adapter firmly against shoulder.
6. Twist the pipe 1/2 turn and allow to dry.
7. Square the copper tubing end with tubing cutter and ream with reamer.
8. Slide the flare nut on the tubing and the flared tubing end.
9. Position the flared tubing end on the adapter and tighten the flare nut to the adapter.
10. Have the instructor check your work.

DUTY: MAINTENANCE PLUMBING - JOINING PIPE

TASK: Using sweat method, join copper tubing/pipe to plastic pipe.

Performance Objectives:

Given two 1' lengths of 1 1/2" diameter pipe (one plastic and one copper), necessary tools and supplies, the student will join the two pipes together, using a sweat adapter to form a watertight seal.

Evaluation Criterion:

The student will join the two pipes to the satisfaction of the instructor.

Performance Guide:

1. Clean the copper pipe end and female adapter with emery cloth.
2. Apply flux or paste to the copper pipe end and female adapter.
3. Insert the copper pipe into the adapter and twist slightly.
4. Light the torch; adjust to the blue flame; heat the areas of copper overlap until the flux or paste bubbles.
5. Apply the solder and allow to cool. Remove the excess solder with cloth.
6. Clean the plastic pipe end and the plastic section of female adapter with cleaner. Allow to dry.
7. Apply cement to the plastic pipe end and the inside of the adapter.
8. Insert the cemented pipe end into the female adapter and butt firmly against the adapter shoulder.
9. Twist the cemented joint 1/2 turn and allow to dry.
10. Have the instructor check your work.

DUTY: MAINTENANCE PLUMBING - JOINING PIPE

TASK: Join copper tubing to steel pipe.

Performance Objectives:

Given a 2' length of 1" diameter copper tubing, a 2' long, 1" diameter threaded steel pipe, a dielectric fitting, necessary tools and materials, the student will join the length of the tubing to the pipe length, using the sweat method.

Evaluation Criterion:

The student will join a length of copper tubing and a length of steel pipe, using a dielectric fitting, to the satisfaction of the instructor.

Performance Guide:

1. Check the copper tubing for the squareness and burrs. Cut and ream if necessary.
2. Disassemble the dielectric fitting.
3. Clean the copper tubing end and the inside of female section of copper fitting with emery cloth.
4. Apply the flux to the cleaned areas of tubing and fitting.
5. Insert the tubing end into the female section of the fitting Twist slightly. Tube end should rest firmly against shoulder of female section.
6. Light torch; adjust to the blue flame; heat the areas of copper overlap until the flux bubbles.
7. Apply solder and allow to cool. Remove the excess solder and flux with cloth.
8. Apply pipe sealant to male pipe threads.
9. Attach the threaded section of fitting to the pipe and tighten.
10. Reassemble the fitting ends together, using wrenches in such a way to avoid the stress on the copper solder joint.
11. Have the instructor check your work.

DUTY: MAINTENANCE PLUMBING - JOINING PIPE

TASK: Join plastic pipe, using solvent cement method.

Performance Objectives:

Given two 3' lengths of 2" diameter PVC pipe, an adapter, plastic pipe cleaner, plastic pipe cement and brush, the student will join the lengths of pipe.

Evaluation Criterion:

The student will join two 3' lengths of 2" diameter PVC pipe, using the adapter-cement method, to the satisfaction of the instructor.

Performance Guide:

1. Check the ends of pipe for squareness and burrs.
2. Clean the pipe ends and fitting sockets with cloth.
3. Apply the pipe cleaner to the outside male end of pipe and inside socket fitting.
4. Apply cement to the male end of pipe and the inside socket of fitting with brush.
5. Insert the male end of pipe fully into socket while cement is still wet: Rotate the pipe 1/2 turn.
6. Repeat Steps 3-5 for the remaining end of fitting and the second length of pipe.
7. Wipe off excess cement after joining each end.
8. Have the instructor check your work.

DUTY: MAINTENANCE PLUMBING - JOINING PIPE

TASK: Join plastic pipe to steel pipe.

Performance Objectives:

Given a 2' length of 1" diameter plastic pipe, a 2' length of 1" diameter steel pipe with threads, a female adapter, and necessary tools and supplies, the student will join the sections of pipe together to form a watertight seal.

Evaluation Criterion:

The student will join a length of plastic pipe to steel pipe to the satisfaction of the instructor.

Performance Guide:

1. Apply the pipe sealant to the male threads of the steel pipe.
2. Attach female plastic adapter to the steel pipe and tighten with wrench.
3. Clean the inside of adapter and the plastic pipe end with cleaner and allow to dry.
4. Apply the plastic cement to the inside of adapter and to the outside of plastic pipe end.
5. Insert the plastic pipe end into adapter. The pipe end should butt firmly against the adapter shoulder.
6. Remove the excess cement.
7. Have the instructor check your work.

DUTY: MAINTENANCE PLUMBING - JOINING PIPE

TASK: Thread steel pipe with nonadjustable die.

Performance Objectives:

Given a ratchet-type, nonadjustable pipe die stock, stand-type vise and pipe threading dies to fit the pipe stock, the student will cut threads on one end of a 1" diameter steel pipe 3' long.

Evaluation Criterion:

The student will cut threads on one end of the pipe, using a hand-operated pipe die stock and dies to the satisfaction of the instructor.

The completed threads must be free of nicks and burrs.

Performance Guide:

1. Secure the pipe in vise.
2. Place the round guide end of pipe die stock on pipe and push pipe threading dies against the pipe with the heel of hand.
3. Exert the pressure with the heel of hand against the pipe die stock, and make several short turns in a clockwise direction to start the threading action.
4. Turn the handle of pipe die stock with even and steady pressure until two newly-cut threads project beyond the head of the die. Oil the pipe threading dies after every two or three downward strokes.
5. Reverse ratchet on the pipe die stock. Make several short motions backward and forward with die stock to loosen burrs inside the dies.
6. Turn the pipe dies stock counterclockwise until the pipe threading dies are free of threads.
7. Have the instructor check your threading.

DUTY: MAINTENANCE PLUMBING - JOINING PIPE

TASK: Replace a section of galvanized water supply line.

Performance Objectives:

Given the necessary tools, equipment, and supplies, the student will replace a section of galvanized water supply line.

Evaluation Criterion:

The student will replace the water supply line to the satisfaction of the instructor.

Performance Guide:

1. Turn off the water supply.
2. Cut pipe at the desired location, using four-wheel cutter.
3. Remove pipe to be replaced from the fitting, disconnecting hangers when necessary.
4. Assemble nipple and half union and connect to the fittings in the supply line.
5. Measure, cut, and thread the replacement pipe, allowing for fittings.
6. Connect unions.
7. Turn on the water supply and check for leaks.
8. Have the instructor check your work.

DUTY: MAINTENANCE PLUMBING - JOINING PIPE

TASK: Repair leaky water faucets or valves.

Performance Objectives:

Given the necessary tools, equipment, and supplies, the student will repair a leaky water faucet.

Evaluation Criterion:

The student will repair a leaky water faucet to the satisfaction of the instructor.

Performance Guide:

1. Shut off water supply to the faucet.
2. Turn the faucet handle to open the faucet.
3. Unscrew the faucet cap, using a strap wrench.
4. Remove th spindle to expose washer.
5. Remove the brass center screw.
6. Lift the washer with knife tip.
7. Replace the washer with new one and tighten.
8. Replace packing washer between cap nut and spindle as follows:
    a. Remove the cap nut and spindle.
    b. Remove the handle from the top of stem.
    c. Replace packing washer.
9. Dress the faucet ground seat as follows:
    a. Insert the seating tool in faucet and press threaded cone down into the body opening.
    b. Center spindle and cutter in the faucet.
    c. Using a moderate downward pressure, rotate the hand wheel to the right to dress seat.
10. Reassemble the remaining parts.

UNIT VII. PLUMBING - DRAINS

Tasks Covered:

1. Install cleanouts on drains. (Theory only)
2. Lay out house drains. (Theory only)
3. Make water tests on building drains. (Theory only)
4. Rough-in waste and vent lines for bathtubs. (Theory only)
5. Rough-in waste and vent lines for built-in lavatories. (Theory only)
6. Rough-in waste and vent lines for floor-mounted water closets. (Theory only)
7. Clear obstructions from lavatory drains.
8. Remove obstructions from main drain lines.
9. Remove obstructions from water closet drains.
10. Replace lavatory trap drains.
11. Repair water flush valves on water closets.

DUTY: MAINTENANCE PLUMBING - DRAINS

TASK: Install cleanouts on drains (Theory only)

Performance Objectives:

Given a lecture presentation on the installation of cleanouts on the drains and the construction plans, the student will learn a proper procedure and the standard requirements for the job.

Evaluation Criterion:

The student will explain the acceptable procedures and job standards to the satisfaction of the instructor.

Performance Guide:

Know the following procedures for the task:

1. Identify the proper location of the cleanout plug from the construction plans.
2. Determine the floor elevation or the wall thickness.
3. Cut and install the hub of drain pipe to accommodate the cleanout placement.
4. Insert a gasket in the hub of the drain pipe.
5. Lubricate the inside of rubber gasket and the outside of the plug pipe.
6. Insert the plug into the drain hub and gasket.
7. Drive the cleanout plug into the drain hub and gasket, using a 2" x 4" block and hammer.
    - a. The cleanout must terminate at an accessible point.
    - b. The cleanout plug must open in the direction of the flow of the drainage line or at right angles.

DUTY: MAINTENANCE PLUMBING - DRAINS

TASK: Lay out house drains. (Theory only)

Performance Objectives:

Given an architect's blueprint for a house, the student will participate in a lecture/discussion on how to lay out house drain lines.

Evaluation Criterion:

The student will demonstrate his knowledge on how to lay out the drain lines for the plumbing by explaining the proper procedures to the satisfaction of the instructor.

Performance Guide:

Know the following proper procedures for the job:

1. Acquire the manufacturer's rough-in specifications.
2. Identify the location of fixtures.
3. Determine elevations and location of drain piping.
4. Determine the type and size of pipe required.
5. Determine the type of fittings for the horizontal and vertical runs.
6. Lay out pipe system on the blueprint, indicating pipe, sizes, elevations, and type of fittings.

DUTY: MAINTENANCE PLUMBING - DRAINS

TASK: Make water tests on building drains. (Theory only)

Performance Objectives:

The student will participate in a lecture/discussion on how to perform a water test on a building drain system for leaks.

Evaluation Criterion:

The student will demonstrate his understanding of the task by explaining the acceptable procedures for the job to the satisfaction of the instructor.

Performance Guide:

Know the following steps for the task:

1. Insert the test plugs in each opening, except the stack above the highest fixture.
2. Connect a water hose to the water supply line and fill the stack above the highest fixture to within 2" of the top with water.
3. Check all plugs and caps for leaks.
4. Allow water to stand in pipe at least 24 hours.
5. Check pipe for leaks, observing sand holes in pipe, cracked fittings and leaks in joints.

DUTY: MAINTENANCE PLUMBING - DRAINS

TASK: Rough-in waste and vent lines for bathtubs. (Theory only)

Performance Objectives:

Given rough-in specifications for a bathtub and a lecture presentation of the task, the student will learn the proper procedures for roughing-in of the waste lines and vent for the bathtub.

Evaluation Criterion:

The student will demonstrate his understanding by explaining the acceptable steps for the job to the satisfaction of the instructor.

Performance Guide:

Know the following procedures:

1. Take the measurements from rough-in specifications.
2. Lay out the waste line from the main line or from the foundation wall to the fixture.
3. Cut pipe to the length.
4. Assemble pipe, leaving the cleanout and vent openings as needed.
5. Align and support pipe.
6. Insert foam cup for the waste line at the tub drain, if installing waste in a concrete slab.
7. Run vent line from soil pipe to re-vent line, or through roof.

DUTY: MAINTENANCE PLUMBING - DRAINS

TASK: Rough-in waste and vent lines for built-in lavatories. (Theory only)

Performance Objectives:

Given a lecture presentation, and the manufacturer's specifications for the fixtures, the student will know the acceptable procedures and standard requirements to rough-in the waste line and vent for a lavatory.

Evaluation Criterion:

The student will demonstrate his knowledge on the proper procedures for the task to the satisfaction of the instructor.

Performance Guide:

Know the following procedures and requirements for the job:

1. Lay out the waste-line from the main-line to the fixture.
2. Measure and cut piping for rough-in plumbing.
3. Assemble piping, using no-hub couplings.
4. Attach 2" x 1 1/4" sanitary tee to the assembly end.
5. Join 1 1/4" galvanized pipe, using tapped tee for connection: Joints must not leak.
6. Align and support the pipe.
7. Run a vent line from the soil pipe to the re-vent line or through roof.

DUTY: MAINTENANCE PLUMBING - DRAINS

TASK: Rough-in waste and vent lines for floor-mounted water closets. (Theory only)

Performance Objectives:

Given a lecture presentation and the rough-in specifications, the student will learn the proper procedures for rough-in of the waste and vent lines for a water closet.

Evaluation Criterion:

The student will demonstrate his knowledge on how to rough-in the waste and vent lines for a water closet to the satisfaction of the instructor.

Performance Guide:

Know the following procedures for the job:

1. Lay out the waste and vent lines, using the rough-in specifications.
2. Cut pipe to the length as required during installation.
3. Assemble pipe in the place, leaving the cleanouts and vent openings.
4. Set a closet collar around waste, using caulk joint.
5. Locate the roof position for the vent pipe.
6. Cut or form vent pipe hole.
7. Connect vent pipe section from the waste line through roof.

DUTY: MAINTENANCE PLUMBING - DRAINS

TASK: Clear obstructions from lavatory drains.

Performance Objectives:

Given necessary tools, equipment and supplies, the student will clear obstructions from a lavatory drain according to the instruction.

Evaluation Criterion:

The student will clear the obstructions from the lavatory drains to the satisfaction of the instructor.

Performance Guide:

1. Remove the cleanout or drain stopper and check for the obstruction: Remove any obstruction and check for the proper drainage.
2. If the problem is not solved, plug the overflow opening with rag and force air and water through the drain line with vacuum plunger.
3. If the problem is not solved, rod out the drain line with flexible cable and auger.
4. If a limited amount of water is moving, pour a caustic chemical into the drain, using the chemical manufacturer's instructions for proper application.
5. If the problem still exists, disassemble, clean, and reassemble the drain and P-trap.
6. Check for the normal flow of water through the lavatory drain.
7. Have the instructor check your work.

DUTY: MAINTENANCE PLUMBING - DRAINS

TASK: Remove obstructions from main drain lines.

Performance Objectives:

Given a power-operated sewer auger and a caustic chemical, and the instruction, the student will remove the obstruction from a main drain line.

Evaluation Criterion:

The student will remove the obstruction from the main drain line to the satisfaction of the instructor.

Performance Guide:

1. Identify the cleanout opening in the drain line. If none exists, remove the appropriate fixture.
2. Attach the proper size bit on the end of rod.
3. Insert the bit and rod into the fixture drain line.
4. Bend the rod as required to reach the obstruction.
5. Activate the power auger. Clean line, removing auger and cleaning as necessary.
6. If tree roots are present in drain, replace the drain line.
7. Run water through the line.
8. Repeat the process until the line is cleaned. A normal flow of water must be accommodated.
9. Replace the fixture.
10. Have the instructor check your work.

DUTY: MAINTENANCE PLUMBING - DRAINS

TASK: Remove obstructions from water closet drains.

Performance Objectives:

Given a vacuum plunger and flexible hand auger, the student will remove the obstruction from a water closet drain.

Evaluation Criterion:

The student will clear the obstruction from a water closet drain to the satisfaction of the instructor.

Performance Guide:

1. Force water through the water closet drain, using a vacuum plunger.
2. Flush water closet; the water closet must flush without overflowing.
3. If the problem still exists, rod out the drain with flexible cable and auger.
4. Remove the auger from the drain, pulling the obstruction with auger.
5. If obstruction cannot be removed with auger, pull water closet and remove the obstruction from the drain.
6. Have the instructor check your work.

DUTY: MAINTENANCE PLUMBING - DRAINS

TASK: Replace lavatory trap drains.

Performance Objectives:

Given an adjustable jaw wrench, the student will replace a faulty lavatory trap.

Evaluation Criterion:

The student will replace a faulty lavatory trap within a length of time considered reasonable by the instructor.

Performance Guide:

1. Disconnect slip-joint nuts at the lavatory trap.
2. Replace the lavatory trap, using the complete kit provided by the manufacturer and other necessary materials.
3. Check to see that there are no leaks at the lavatory trap.

DUTY: MAINTENANCE PLUMBING - DRAINS

TASK: Repair water flush valves on water closets.

Performance Objectives:

Given the necessary tools, equipment, and repair supplies, the student will repair a diaphragm-type flush valve on a water closet.

Evaluation Criterion:

The student will repair a diaphragm-type flush valve on a water closet to the satisfaction of the instructor.

Performance Guide:

1. Cut water supply off at the fixture stop valve.
2. Remove the top from the tank.
3. Remove the nut from underside of closet tank which holds flush valve and lift the flush valve from the tank.
4. Remove the diaphragm and rubber seat from the guide.
5. Replace diaphragm, plunger, and seat washer, if worn, with new parts.
6. Replace the diaphragm guide with new parts if necessary.
7. Replace the flush valve when the above steps are inappropriate.
8. Replace the flush valve tank top.
9. Turn water on.
10. Check the operation of valve. The flush valve must provide a rapid automatic delivery of water and must not overflow the fixture.
11. Have the instructor check your work.

MAINTENANCE MECHANICS

UNIT VIII. PLUMBING - VENTS

Tasks Covered:

1. Install soil or waste back vents. (Theory only)
2. Install vent terminals (roof-flashing). (Theory only)

DUTY: MAINTENANCE PLUMBING - VENTS

TASK: Install soil or waste back vents. (Theory only)

Performance Objectives:

Given rough-in specifications by the fixture manufacturer and a lecture presentation, the student will know the acceptable procedures and standard requirements for the installation of a back vent in a plumbing system which accommodates fixtures for two bathrooms installed back to back.

Evaluation Criterion:

The student will demonstrate his understanding of the work procedures for the job to the satisfaction of the instructor.

Performance Guide:

Know the following procedures for the job:

1. Determine the height required for the vent line.
    a. The vent connection must be made at least 6" above the flood-level rim of the fixtures.
    b. All joints must be leakproof.
2. Lay out piping and fittings for the horizontal cross vent.
3. Assemble pipe sections.
4. Connect pipe sections from the fixture drain to main vent or stack.
5. Check the grade of horizontal pipe.

DUTY: MAINTENANCE PLUMBING - VENTS

TASK: Install vent terminals (roof-flashing). (Theory only)

Performance Objectives:

Given a lecture presentation, the student will know the proper procedures for installation of vent terminals.

Evaluation Criterion:

The student will demonstrate his understanding of installation procedure for vent terminals.

Performance Guide:

Know the following procedures:

1. Select the vent terminal to match the pitch of the roof.
2. Slip the vent terminal over the vent pipe extending through roof.
3. Depending on the type of vent terminal, bend the terminal top over vent.
4. Seal the flashing with tar compound. The terminal must be watertight.

MAINTENANCE MECHANICS

UNIT IX. PLUMBING - AIR CONDITIONING AND HEATING

Tasks Covered:

1. Bend copper tubing with spring bender.
2. Braze pipe with gas torch and filler metal.
3. Cut copper tubing with hacksaw.
4. Cut copper tubing with tubing cutter.
5. Join copper tubing/pipe to copper pipe/tubing.
6. Join copper tubing with compressed connectors.
7. Install temperature and pressure relief valves on boilers. (Theory only)
8. Clean deposits from boilers. (Theory only)
9. Perform leak tests on gas supply lines. (Theory only)
10. Clean and adjust gas burners. (Theory only)
11. Install check valves on water feed lines. (Theory only)
12. Install strainers in condensate-return lines. (Theory only)

DUTY: MAINTENANCE PLUMBING - AIR CONDITIONING AND HEATING

TASK: Bend copper tubing with spring bender.

Performance Objectives:

Given a 1/2" spring bender, a 3' section of 1/2" diameter soft copper tubing, and a flat working space, the student will bend the copper tubing to an angle of 90°.

Evaluation Criterion:

The student will bend copper tubing to an angle of 90° within a tolerance of ± 3°. No crimps should appear in the completed bend.

Performance Guide:

1. Insert the tubing into bender.
2. Clasp-spring the enclosed tubing with both hands, thumbs pointing inward one inch apart.
3. Form a bend with thumb and hand pressure.
4. Check bend angle.

DUTY: MAINTENANCE PLUMBING - AIR CONDITIONING AND HEATING

TASK: Braze pipe with gas torch and filler metal.

Performance Objectives:

Given an oxyacetylene torch, brass brazing rods and clamps for drawing the pipe ends together, the student will braze a 1/2" diameter copper pipe joint.

Evaluation Criterion:

The student will use an oxyacetylene torch and a brass brazing rod to braze a 1/2" diameter copper pipe joint to the instructor's satisfaction.

Performance Guide:

1. Square the ends of pipe, if necessary.
2. Bevel the pipe ends to be brazed with a file.
3. Support two sections of pipe to be brazed in a level position.
4. Draw pipe ends together with a clamp and turnbuckle.
5. Light the oxyacetylene torch and adjust flame.
6. Heat pipe ends to be joined to the correct temperature.
7. Hold the torch in one hand and brazing rod in other. Apply heat as needed while brazing the joint: Braze the pipe until a smooth joint is made around the pipe.
8. Have the instructor check your work.

DUTY: MAINTENANCE PLUMBING - AIR CONDITIONING AND HEATING

TASK: Cut copper tubing with hacksaw.

Performance Objectives:

Given a 6' folding rule, a 2' length of 3/8" diameter copper tubing, holding device, hacksaw, and reamer, the student will measure and cut a 6" length from the copper tubing.

Evaluation Criterion:

The student will cut 6" from the copper tubing within a tolerance of ± 1/8". All burrs must be removed from the cut ends.

Performance Guide:

1. Measure and mark the piece to be cut from tubing.
2. Secure the tubing in a holding device.
3. Center the cutting edge of hacksaw on the mark.
    a. Move the hacksaw blade back and forth slowly on the mark to begin the cut.
    b. Cut the tubing with back and forth sawing action.
4. Ream the cut ends.

DUTY: MAINTENANCE PLUMBING - AIR CONDITIONING AND HEATING

TASK: Cut copper tubing with tubing cutter.

Performance Objectives:

Using a tubing cutter, the student will cut a 2" length from a 1' section of diameter copper tubing.

Evaluation Criterion:

The student will cut 2" from the tubing within a tolerance of ± 1/16". The cut tubing end must be free of burrs and not flattened.

Performance Guide:

1. Measure and mark the tubing length to be cut.
2. Place the tubing cutting wheel on the mark where tubing is to be cut.
3. Rotate the cutter around the circumference of the tubing.
4. Tighten the cutting wheel and repeat Step 3 as often as needed to complete the cut.
5. Ream the cut end to remove the burrs.

DUTY: MAINTENANCE PLUMBING - AIR CONDITIONING AND HEATING

TASK: Join copper tubing/pipe to copper pipe/tubing.

Performance Objectives:

Given necessary tools, equipment and supplies, the student will join two short lengths of 3/4" diameter rigid copper tubing.

Evaluation Criterion:

The student will join the two ends together with a sweat fitting. The joint should not leak.

Performance Guide:

1. Ream and clean the ends to be soldered.
2. Apply flux or paste to the outside of tubing and inside of coupling.
3. Slide the tubing ends into coupling and support the assembly.
4. Apply heat evenly around the fitting with oxyacetylene torch. When flux or paste bubbles out around the joint, remove the torch flame.
5. Apply solder to joints around the fitting ends. When a line of solder shows completely around the joint, the connection is filled with solder.
6. Clean flux or paste and solder residue from the joint.
7. Have the instructor check your work.

DUTY: MAINTENANCE PLUMBING - AIR CONDITIONING AND HEATING

TASK: Join copper tubing with compressed connectors.

Performance Objectives:

Given the necessary tools, equipment and supplies, the student will join the tubing together using a compression union.

Evaluation Criterion:

The student will connect two sections of copper tubing with a compression union. The joint should not leak.

Performance Guide:

1. Square the tubing ends and remove burrs if necessary.
2. Insert the nut and ferrule onto the end of tubing.
3. Insert the tubing end into female center portion of the union.
4. Position the nut and ferrule and tighten with wrenches. Ferrule is compressed, forming the seal.
5. Repeat the Steps 2, 3, and 4 for the remaining side.
6. Have the instructor check the connection.

DUTY: MAINTENANCE PLUMBING - AIR CONDITIONING AND HEATING

TASK: Install temperature and pressure relief valves on boilers. (Theory only)

Performance Objectives:

Given a lecture presentation on how to install a temperature and pressure relief valve, the student will learn the proper steps and the requirements for the task.

Evaluation Criterion:

The student will demonstrate his understanding of the proper procedures for the installation of a temperature and pressure relief valve on a boiler to the satisfaction of the instructor.

Performance Guide:

Know the following procedures for the job:

1. Attach the temperature and pressure relief valve as specified by the boiler manufacturer to the relief port.
2. Connect the pipe to valve and run to the nearest drain opening.
3. Check the relief of boiler water, using the manual trip lever.
4. Fire the boiler to the temperature and pressure required for the activation of the valve. Valve must activate at the temperature and pressure indicated.

DUTY: MAINTENANCE PLUMBING - AIR CONDITIONING AND HEATING

TASK: Clean deposits from boilers. (Theory only)

Performance Objectives:

Given a lecture presentation for the topic, the student will learn to identify the necessary equipment and supplies and the proper procedures for cleaning deposits from a fire tube boiler.

Evaluation Criterion:

The student will demonstrate his understanding of the task to the satisfaction of the instructor.

Performance Guide:

Know the following procedures for the job:

1. Drain the boiler and let cool.
2. Ream the scale from fire tubes using a brush and rod.
3. Remove the scale particles with compressed air or rag over brush.
4. Install a chemical pump in a make-up water line.
5. Flush out the system and scale deposits with water.
6. Add suitable neutralizer to system.

DUTY: MAINTENANCE PLUMBING - AIR CONDITIONING AND HEATING

TASK: Perform leak tests on gas supply lines. (Theory only)

Performance Objectives:

Given a lecture presentation on the leak test for the gas supply line, the student will learn to identify the necessary equipment, and the proper procedures for the leak test.

Evaluation Criterion:

The student will demonstrate his understanding of the task to the satisfaction of the instructor.

Performance Guide:

Know the following:
1. Select the necessary tools and equipment including an air compressor equipped with a pressure gauge and pipe fitting.
2. Cap all gas risers.
3. Connect the air compressor to the line.
4. Run the compressor until a desired pressure has been reached.
5. Check for a drop in pressure.

DUTY: MAINTENANCE PLUMBING - AIR CONDITIONING AND HEATING

TASK: Clean and adjust gas burners. (Theory only)

Performance Objectives:

Given a lecture presentation, the student will learn the proper procedures for cleaning and adjusting the burners.

Evaluation Criterion:

The student will demonstrate his knowledge of how to clean and adjust the burners to the satisfaction of the instructor.

Performance Guide:

Know the following procedures for the job:

1. Cut off the gas supply.
2. If necessary, remove the gas burner.
3. Clean the burner with air gun forcing air over the burner and into the burner ports.
4. Turn on the gas supply and light the burner.
5. Loosen the air shutter screw and adjust the burner air intake. Adjust the airflow until a greenish-blue flame is obtained.
6. The gas burner must not smoke when put in operation.

DUTY: MAINTENANCE PLUMBING - AIR CONDITIONING AND HEATING

TASK: Install check valves on water feed lines.
(Theory only)

Performance Objectives:

Given a lecture presentation on the installation of the check valve on the water supply lines, the student will learn the proper procedures for the task.

Evaluation Criterion:

The student will demonstrate his understanding of the task to the satisfaction of the instructor.

Performance Guide:

Know the following procedures for the job:

1. Determine the direction of the water flow in the supply line.
2. Identify the proper direction of the water flow in the valve.
3. Measure, cut and thread the pipe for the inlet and outlet supply.
4. Assemble the components.
5. Connect the union in the supply line.
6. Connect the valve. If it is a swing-type check valve, install with a swing pendulum in downward position.

DUTY: MAINTENANCE PLUMBING - AIR CONDITIONING AND HEATING

TASK: Install strainers in condensate-return lines. (Theory only)

Performance Objectives:

Given a lecture presentation on the installation of the strainer in a condensate return line, the student will learn the proper procedures for the task.

Evaluation Criterion:

The student will demonstrate his understanding of the task to the satisfaction of the instructor.

Performance Guide:

Know the following procedures for the job:
1. Determine the desired location of the strainer.
2. Measure and cut the pipe at the strainer's location.
3. Prepare the pipe ends for the installation of the strainer.
4. Connect the strainer to the end of supply pipe. Note the direction of the water flow indicated on the strainer and the accessibility for cleaning.
5. Install the nipple and half union on the outlet side of the strainer.
6. Install the half union on the water outlet pipe end.
7. Connect the half unions.
8. The pipe joints must not leak. Water must flow freely through the strainer.

MAINTENANCE MECHANICS

UNIT X. CARPENTRY - BUILDING MATERIALS

Tasks Covered:

1. Identify actual sizes of milled lumber in relation to nominal sizes.
2. Identify defects and blemishes that affect durability and strength of lumber.
3. Stack and care for lumber.
4. Identify job safety requirements.

DUTY: MAINTENANCE CARPENTRY - BUILDING MATERIALS

TASK: Identify actual sizes of milled lumber in relation to nominal sizes.

Performance Objectives:

Given a list of nominal sizes of lumber, the student will give the actual size for each of the lumber on the list.

Evaluation Criterion:

The student will identify the actual sizes of the lumber on the list with 90% accuracy.

Performance Guide:

1. Match the sample pieces of lumber with their nominal sizes: 2x4; 2x6; 2x8; 2x10; 2x12; 1x3; 1x4; 1x6; 1x8; 1x10; 1x12; and 4x4.
2. Measure each piece for its actual size.

DUTY: MAINTENANCE CARPENTRY - BUILDING MATERIALS

TASK: Identify defects and blemishes that affect durability and strength of lumber.

Performance Objectives:

Given an illustration of lumber defects, the student will identify three kinds of knots and three types of warps that affect the durability and strength of lumber.

Evaluation Criterion:

The student will identify the lumber defects and explain how they affect the lumber to the satisfaction of the instructor.

Performance Guide:

1. Study the illustration and identify the lumber defects.

DUTY: MAINTENANCE CARPENTRY - BUILDING MATERIALS

TASK: Stack and care for lumber.

Performance Objectives:

Given a truck load of framing material, the student will unload the material and stack in a sequence in terms of which material will be used first.

Evaluation Criterion:

The student will unload and stack the material according to the standard procedures explained by the instructor. The widest and longest pieces will be placed on the bottom while the short thin pieces will be on top.

Performance Guide:

1. Determine the location to unload lumber.
2. Identify the sequence of material to be used.
3. Place skids at appropriate intervals to receive materials .
4. Place longest and widest material on skids first, then the shorter, thinner material (if the order of sequence is not violated).

MAINTENANCE MECHANICS

UNIT XI. CARPENTRY - HAND AND POWER TOOLS

Tasks Covered:

1. Use personal protective equipment.
2. Bore holes with drill press. (Theory only)
3. Check installation for level and plumb with a carpenter's level.
4. Copy and transfer angles using sliding T-bevel and framing combination squares as layout tools.
5. Read and measure with rules and squares.
6. Cut chamfers with table saw.
7. Cut compound miters with table saw.
8. Cut dado with portable router.
9. Cut irregular shaped patterns with saber and band saws.
10. Cut large sheets of plywood and wallboard with table saws.
11. Drill-bore holes with portable hand drill.
12. Glue wood stock with hand and bar clamps.
13. Joint stock with the jointer.
14. Make butt joints.
15. Make dado joints.
16. Make lap joints.
17. Make miter joints.
18. Make rabbet joints.
19. Plane stock to thickness with single surface planer (surfacer)
20. Rip plywood with portable saw.
21. Sand finish materials by hand.
22. Sand surfaces and edges with belt sander.
23. Select proper hammer and drive various types and sizes of nails.
24. Set nails with nail set and apply wood filler.
25. Service and maintain portable woodworking power tools.

DUTY: MAINTENANCE CARPENTRY - HAND AND POWER TOOLS

TASK: Identify job safety requirements.

Performance Objectives:

Given pertinent standards and the description of two jobs, the student will write the safety requirements for the jobs.

Evaluation Criterion:

The student will write the safety requirements consistent with the standards for the specific jobs to the instructor's satisfaction.

Performance Guide:

1. Secure the descriptions of the jobs and pertinent documents containing the pertinent safety information.
2. Locate sections of information which relate to the specific job descriptions.
3. Record this information.
4. Have the instructor check your report.

DUTY: MAINTENANCE CARPENTRY - HAND AND POWER TOOLS

TASK: Use personal protective equipment.

Performance Objectives:

Given a lecture presentation on the personal protection guidelines, personal protection equipment and a work situation, the student will select and explain the use of the personal protection equipment as required. The student will state the requirements as to where and when the hard hats, gloves and special equipment must be worn.

Evaluation Criterion:

The student will demonstrate knowledge of the use of the personal protective equipment to meet specific work situations' requirements to the satisfaction of the instructor.

Performance Guide:

1. Cover the following safety requirements:
   a. Wear approved hard hats at all times on the job.
   b. Wear approved work gloves when needed. Gloves will not be used when operating rotary type machinery.
   c. Wear approved safety shoes when recommended.
   d. Wear approved eye and face protection when warranted.
   e. Wear special equipment such as safety belts, dust respirators, metal shin guards, and neoprene weather clothing when required.

DUTY: MAINTANANCE CARPENTRY - HAND AND POWER TOOLS

TASK: Bore holes with drill press. (Theory only)

Performance Objectives:

Given a lecture presentation and reference materials, the student will demonstrate his understanding of how to drill holes as specified.

Evaluation Criterion:

The student will explain, to the instructor's satisfaction, the following acceptable standards in drilling holes:

a. Holes will be 90° to the surface of the stock. (± 2°)
b. Diameter of the hole will correspond to the hole specifications.
c. Hole will be drilled at a predetermined location. (± 1/32")
d. Depth of the hole will be according to the specifications. (± 1/16")

Performance Guide:

Review the materials covered and know the following steps:

1. Select a correct type and size of drill.
2. Insert the drill into chuck.
3. Adjust table to the correct height and angle.
4. Position table so the clearance hole on drill press is lined up with carter of the drill.
5. Adjust the spindle depth gage.
6. Select proper speed.
7. Drill hole to correct size and location.

DUTY: MAINTENANCE CARPENTRY - HAND AND POWER TOOLS

TASK: Check installation for level and plumb with a carpenter's level.

Performance Objectives:

Given a 4' carpenter's level and a partner, the student will check door jams, window frames and partition walls for level and plumb requirements.

Evaluation Criterion:

The student will complete the check on each unit on the following acceptable standards.

- a. The units will be level.
- b. The units will be plumb.
- c. The units will be positioned according to the specifications. (± 1/16")

Performance Guide:

The student will learn the following steps.

Testing for levelness:

1. Place the level on the horizontal surface to be tested.
   - a. Make sure that the body of the level is parallel with the edge of the surface being tested.
   - b. Make sure that there are no particles of dirt or any irregular surfaces between the level and the board.
2. Refer to the bottom tube located in the center of the level and observe the position of the bubble.
   - a. Note that this bubble has the crowned side up.
   - b. If the bubble rests to the right or left of the center of the lines on the tube, the surface is not level.
3. To level the surface, raise or lower one end of the surface until the bubble is centered between the lines.
4. To level or plumb a long surface, use a straight edge with the spirit level.
   If the long surface is crowned, place the straight edge against the opposite or hollow side of the board.

Testing for plumbness:

1. Place the level against one side of the surface to be

DUTY: MAINTENANCE CARPENTRY - HAND AND POWER TOOLS

TASK: Check installation for level and plumb with a carpenter's level.

Performance Guide (cont.):

tested.

2. Observe the position of the bubble in the crowned tube.
   a. If the bubble rests to the right or left of the center lines, the surface being tested is not plumb.
3. Check the accuracy of the level by observing the bubble in the lower tube.
   a. The bubble should be in the same position in the lower tube as the bubble in the upper tube.
   b. If it is not, the level is out of adjustment.
4. Place the level on the opposite side of the surface being tested.
   a. If the top bubble does not rest in the center as before, the surface is not plumb.
   b. It is assumed that the side opposite to the one being tested is parallel to it.
5. In order to plumb the surface with the level, it is necessary to tilt the surface on the level when the level is placed on the side (and the opposite side) of the surface being tested.

DUTY: MAINTENANCE CARPENTRY - HAND AND POWER TOOLS

TASK: Copy and transfer angles using sliding T-bevel and framing combination squares as layout tools.

Performance Objectives:

Given a carpenter's framing square, a sliding T-bevel and specifications, the student will lay out and transfer required angles according to specifications.

Evaluation Criterion:

The student will transfer the required angles to the satisfaction of the instructor. All angles must be $\pm 2^\circ$.

Performance Guide:

1. Place the body of square against one edge of the board and mark along the outside edge of the tongue.
2. Set the T-bevel to the required angle.
3. Transfer the angle to material.
4. Have the instructor check your work.

DUTY: MAINTENANCE CARPENTRY - HAND AND POWER TOOLS

TASK: Read and measure with rules and squares.

Performance Objectives:

Given rule or square and stock, the student will measure and record the dimensions of various different sizes of stock to the nearest 1/16", and draw lines of various length as directed.

Evaluation Criterion:

The student will measure the stock with rule or square, and draw lines to the predetermined lengths.

Performance Guide:

1. Measure each piece of stock and record the dimensions.
2. Draw lines to predetermined lengths.

DUTY: MAINTENANCE CARPENTRY - HAND AND POWER TOOLS

TASK: Cut chamfers with table saw.

Performance Objectives:

Given a tilting arbor table saw, stock, carpenter's rule and the job specifications for two chamfers (one 1/8" x 45°; and another 30-60° x 1/8" on 30° side), the student will cut the chamfers to the specifications.

Evaluation Criterion:

The student will cut the chamfers to the satisfaction of the instructor within the tolerance limits: Measurements to be correct to ± 1/32"; and the angles to be ± 2°.

Performance Guide:

1. Tilt the arbor to the required angle.
2. Adjust the saw blade to the proper height.
3. Secure the fence in a correct position.
4. Make a trial cut to check for the desired angle.
5. Make the chamfer cuts.
6. Have the instructor check your cuts.

DUTY: MAINTENANCE CARPENTRY - HAND AND POWER TOOLS

TASK: Cut compound miters with table saw.

Performance Objectives:

Given a tilting arbor table saw, supply of molding material, the necessary supporting tools, detailed drawings and specifications, and table of compound miters, the student will cut compound miter joints.

Evaluation Criterion:

The student will cut and fit the required compound miters according to the instructions and layout requirements within a time period considered reasonable by the instructors.

The finish cut will be in accordance with the specified angles (± 1°); the stock will be cut to the correct length (± 1/32").

Performance Guide:

1. Set the miter gauge to the specified angle.
2. Adjust the blade to the specified angle.
3. Adjust the blade to the proper height.
4. Make a trial cut to check angles.
5. Hold the stock securely against the miter gauge while making the finish compound miter cut.
6. Have the instructor check your cut.

DUTY: MAINTENANCE CARPENTRY - HAND AND POWER TOOLS

TASK: Cut dado with portable router.

Performance Objectives:

Given a portable hand router with gauge, a straight router bit, a straight edge guide and pieces of 3/4" stock, the student will cut a series of dados 3/4" wide, 3/8" deep, and spaced 2" on the center across the width of the board.

Evaluation Criterion:

The student will cut a series of dados with a portable router to the satisfaction of the instructor. The dado will be straight and parallel (tolerance ± 1/32"); the cuts will not vary in depth or width (± 1/32" tolerance); the cuts will be 90° (± 1°) to the edge of the stock.

Performance Guide:

1. Select a straight router bit of specified size.
2. Secure the bit in the chuck of router.
3. Adjust the base of the router to obtain the correct depth of cut.
4. Adjust the straight edge guide to the specified position.
5. Secure the stock in a horizontal position on the bench.
6. Check all the adjustments.
7. Cut the dados.
8. Cuts wider than the diameter of the cutter head may be accomplished by changing the guide and making a series of cuts.

DUTY: MAINTENANCE CARPENTRY - HAND AND POWER TOOLS

TASK: Cut irregular shaped patterns with saber and band saws.

Performance Objectives:

Given a demonstration, an irregular shaped pattern of special design, or a pattern design drawn to scale on a graph paper, band saw or a saber saw and the necessary stock, the student will transfer the pattern to the stock and cut it to the pattern.

Evaluation Criterion:

The student will cut the stock to the specified pattern to meet the instructor's approval.

Performance Guide:

1. Determine the width of the saw blade.
2. Check to make sure all the layout lines are clearly visible.
3. Adjust the saw guide to the proper height.
4. Make smooth cut on waste side of line or cut to line when required.
5. Make all cuts free of splinters top and bottom.
6. Make all cuts perpendicular to the surface of the stock (± 2°).
7. Make sure all curves, bends, and turns are smooth and regular.
8. The finished cut must correspond in exactness with the pattern design and specifications.
9. Have the instructor check your work.

DUTY: MAINTENANCE CARPENTRY - HAND AND POWER TOOLS

TASK: Cut large sheets of plywood and wallboard with table saw.

Performance Objectives:

Given a demonstration, necessary materials, tools, helper and job specifications, the student will cut the plyboards to the specified sizes and shapes.

Evaluation Criterion:

The student will cut a 4' x 8' plywood into the sizes specified in the job order conforming the layout to the specifications.

Performance Guide:

1. Select a proper blade.
2. Set the blade 1/4" above the thickness of the stock.
3. Adjust the fence to a proper position.
4. Feed the sheet of plywood through the saw with the edge against the fence. Make sure the saw kerf is on the waste side of the line; the cut will be 90° to the surface.
5. Have the helper support the stock on the outfeed side of the saw.
6. Make sure that the splinter guard is working.
7. The final cut will be according to the specification (± 1/16").
8. Have the instructor check your cut.

DUTY: MAINTENANCE CARPENTRY - HAND AND POWER TOOLS

TASK: Drill-bore holes with portable hand drill.

Performance Objectives:

Given a demonstration, a portable hand drill, a complete set of power bits 1/4" through 1 1/8", a five-dimensioned layout with specifications as to the location and size of a series of holes, and wood stock, the student will lay out, mark and bore the holes to the acceptable standards.

Evaluation Criterion:

The student will complete the task to the satisfaction of the instructor.

Performance Guide:

1. Determine the location of holes from the job specification.
2. Mark the location of each hole on the stock.
3. Clamp the stock to the horizontal surface.
4. Select a correct size drill bit.
5. Install the drill bit in the chuck.
6. Drill the holes to the correct angle and depth.
7. To avoid splintering, place a waste piece of stock under the piece to be bored.
8. Make sure the following standards are met:
    a. Hole size will match the layout.
    b. Locations of the holes are accurate to within ± 1/16".
    c. Holes are perpendicular to the surface $\pm 2^{\circ}$.
    d. The back of the stock is free of splinters.
9. Have the instructor approve your work.

DUTY: MAINTENANCE CARPENTRY - HAND AND POWER TOOLS

TASK: Glue wood stock with hand and bar clamps.

Performance Objectives:

Given precut and fitted wood stock for a specific installation, the student will apply glue to the bonding surface, and assemble the parts and install clamps.

Evaluation Criterion:

The student will glue the wood stock for a required installation to the satisfaction of the instructor.

Performance Guide:

1. Secure pieces of scrap wooden blocks to place between the stock and clamps.
2. Obtain the required number of clamps.
3. Clamp the work together without glue.
4. Check the surfaces and angles. Align all parts properly.
5. Make corrections on the stock if required.
6. Remove the clamps.
7. Apply glue evenly to all bonding surfaces with no visual openings (cracks).
8. Replace the clamps. Use wooden scrap pieces to protect the edges of wood from the clamp marks when necessary.
9. Check the surfaces and angles.
10. Wipe off excess glue.
11. Set the work aside in such a position that there will be no wind or twist.
12. Have the instructor check your work.

DUTY: MAINTENANCE CARPENTRY - HAND AND POWER TOOLS

TASK: Joint stock with the jointer.

Performance Objectives:

Given a power jointer and the necessary wood stock, the student will joint (plane) the stock to the specifications.

Evaluation Criterion:

The student will complete the task to the satisfaction of the instructor.

Performance Guide:

1. Plane the surface of a board smooth and true.
2. Plane the edge of the board straight and at a 90° angle.
3. Plane the edges of two boards square and straight, without any irregularities of cut.
4. Adjust the fence to proper position and angle.
5. Adjust the depth of the cut by moving the infeed table to required position.
6. Make cut by feeding the stock into the cutterhead with the grain, holding the stock down on the outfeed table to insure a straight cut.
7. Have the instructor check your cut.

DUTY: MAINTENANCE CARPENTRY - HAND AND POWER TOOLS

TASK: Make butt joints.

Performance Objectives:

Given a saw, stock and necessary fasteners and/or glue, the student will cut the stock to form butt joint.

Evalution Criterion:

The student will make butt joints to the satisfaction of the instructor.

Performance Guide:

1. Obtain the stock.
2. Lay out the stock.
3. Cut the stock to the specified dimensions.
4. Check the assembled joint. The joint will have no visual openings.
5. Fasten the joint with the required material. The resulting end butt joint will be 90°.

DUTY: MAINTENANCE CARPENTRY - HAND AND POWER TOOLS

TASK: Make dado joints.

Performance Objectives:

Given stock, appropriate hand and/or machine tools and a description of dado joint, the student will cut the stock to the correct dimensions.

Evaluation Criterion:

The student will construct the dado joint to the satisfaction of the instructor.

Performance Guide:

1. Locate the position of the joint on stock.
2. Lay out and mark dado 90° to the edge of the stock.
3. Measure the thickness of board that is to fit into the dado.
4. Assemble dado head to the thickness determined in Step 3.
5. Adjust dado head to the correct position.
6. Adjust fences and gauges as the joint requires.
7. Cut dado in scrap material.
8. Check the resulting dimensions of cut: Depth ± 1/32"; width ± 1/32" and to the specified angle.
9. Make corrections if necessary.
10. Cut dado joints as required.
11. Have the instructor check your dado cut.

DUTY: MAINTENANCE CARPENTRY - HAND AND POWER TOOLS

TASK: Make lap joints.

Performance Objectives:

Given stock, proper hand or power tools and description of lap joint, the student will cut stock to the correct dimensions.

Evaluation Criterion:

The student will cut lap joints to the satisfaction of the instructor.

Performance Guide:

1. Square the ends of the stock to be jointed.
2. Reduce both pieces of the stock to the same thickness.
3. Lay out and mark the face of the stock.
4. Set marking gauges to one-half the thickness of the stock.
5. Cut the stock on the waste side of the line and to the correct depth: (± 1/32").
6. Make a trial assembly of joint. The joint will be without gaps (± 1/32").
7. Make corrections if necessary.
8. Have the instructor approve your work.

DUTY: MAINTENANCE CARPENTRY - HAND AND POWER TOOLS

TASK: Make miter joints.

Performance Objectives:

Given a miter box or electric miter box saw, layout tools, required fasteners, stock and instructions, the student will cut and assemble a 90° miter joint.

Evaluation Criterion:

The student will cut miter joints with miter box saw to the satisfaction of the instructor.

Performance Guide:

1. Determine the miter joint dimensions.
2. Lay out and mark the stock.
3. Adjust the saw to 45°.
4. Cut miters to line (holding the stock firmly). The cut will be 90° from surface of the stock.
5. Check the joints for the accuracy.
6. Assemble joints as required by instructions:
   a. No visual openings will exist in the finished joint.
   b. The finished miter joint will be 90°.
   c. The completed miter joint will conform to the specifications.
7. Have the instructor approve your work.

DUTY: MAINTENANCE CARPENTRY - HAND AND POWER TOOLS

TASK: Make rabbet joints.

Performance Objectives:

Given stock, joint specifications, table saw, marking gauge and try square, the student will cut a rabbet joint.

Evaluation Criterion:

The student will construct a rabbet joint to the satisfaction of the instructor.

Performance Guide:

1. Square the two pieces to be joined to the exact length.
2. Lay out and mark a rabbet joint.
3. Adjust the saw blade to the correct height.
4. Adjust the miter gauge.
5. Cut rabbet to the specifications:
   a. The rabbet will form a 90° angle.
   b. The width and depth of the rabbet will be correct to ± 1/32".
   c. The rabbet will be parallel to the face surface.
6. Have the instructor approve your work.

DUTY: MAINTENANCE CARPENTRY - HAND AND POWER TOOLS

TASK: Plane stock to thickness with single surface planer (surfacer).

Performance Objectives:

Given a single surface planer, stock with one surface and the specifications, the student will surface-plane the stock to the required thickness.

Evaluation Criterion:

The student will surface plane to the required thickness to the satisfaction of the instructor.

Performance Guide:

1. Determine the finished thickness and the rough thickness of the stock to be surface planed.
2. Check the stock for foreign material such as grit, paint, nails, etc.
3. Check the grain of the stock after all foreign material has been removed. The stock will be planed with the grain to the extent possible.
4. Set the bed of surface planer for the desired cut.
5. Feed the stock in at right angle to the cutterhead.
6. Check the thickness of the stock: (± 1/32").
7. Reset the bed of the sruface planer for the desired cut.
8. Continue making cuts until the specified thickness is reached: 1/16" maximum cut for wide stock and 1/8" maximum cut for narrow stock.
9. The stock will be free of chip impressions.
10. Have the instructor approve your work.

DUTY: MAINTENANCE CARPENTRY - HAND AND POWER TOOLS

TASK: Rip plywood with portable saw.

Performance Objectives:

Given a portable power saw, 4" x 8" sheet of plywood, saw horses, a helper and the job specifications, the student will cut the plywood to the required specifications.

Evaluation Criterion:

The student will rip the plywood using a portable saw to the satisfaction of the instructor.

Performance Guide:

1. Check the dimensions on the specifications.
2. Place plywood in horizontal position with saw horses at appropriate locations.
3. Mark line according to the specifications.
4. Cut the plywood on the waste side of the line. The cut will be 90° to the surface of plywood: ± 2°.
5. Have the instructor check your cut.

DUTY: MAINTENANCE CARPENTRY - HAND AND POWER TOOLS

TASK: Sand finish materials by hand.

Performance Objectives:

Given stock, sanding block and sandpaper, the student will finish sanding the stock to prepare the surface for finishing.

Evaluatior Criterion:

The student will finish sanding the stock by hand to the satisfaction of the instructor.

Performance Guide:

1. Check the surface for defects.
2. Repair the defects if necessary.
3. Tear 9" x 11" sheet of sandpaper into 4 equal parts.
4. Fold the sandpaper around the sanding block.
5. Sand the surface with the grain.
6. Check the surface to insure the proper sanding:
   a. Sanding will be done with the grain.
   b. All pencil and small scratches will be removed.
   c. The finished surface will be smooth.
7. Have the instructor approve your work.

DUTY: MAINTENANCE CARPENTRY - HAND AND POWER TOOLS

TASK: Sand surfaces and edges with belt sander.

Performance Objectives:

Given stock, a belt sander and assortment of belts, the student will sand the surface and edges of the stock to the specified requirements.

Evaluation Criterion:

The student will sand to the specified size and shape with a belt sander.

Performance Guide:

1. Secure the work piece in horizontal position.
2. Select an appropriate size belt sander for the specified job.
3. Select an appropriate abrasive belt for the sanding job.
4. Sand the work to the requirements:
    a. Surfaces to be sanded smooth.
    b. Finished stock to be of the predetermined size and shape.
    c. No visible burn marks.
    d. Surface to be free of cross grain scratches.
5. Have the instructor check your sanding job.

DUTY: MAINTENANCE CARPENTRY - HAND AND POWER TOOLS

TASK: Select proper hammer and drive various types and sizes of nails.

Performance Objectives:

Given pieces of stock to be joined, assortment of nails, and hammers of three different weights (13 oz.; 16 oz.; 20 oz), the student will select the appropriate type and size of nail for pieces of stock to be joined and use the appropriate weight hammer to drive the nails.

Evaluation Criterion:

The student will join pieces of stock with appropriate nails and correct weight hammer.

Performance Guide:

1. Select the correct type and size of the nail. The length of the nail should be about three times the thickness of the first board (a thinner of the two boards to be joined). i.e., Bottom 2/3 of the nail should be in the second board.
2. Start the nail at desired angle with light taps of hammer.
   a. Locate nails away from edge of stock to prevent splitting.
   b. Stagger the nails so that the nails will not be in line with each other in the same grain.
   c. Do not drive the nails into defects of wood.
3. Use the maximum leverage of the hammer to drive nail into wood.
4. Drive the head of nail flush with the surface of wood. Heads of nails will not protrude above the surface of wood or be bent over into wood.
5. Have the instructor check your work.

DUTY: MAINTENANCE CARPENTRY - HAND AND POWER TOOLS

TASK: Set nails with nail set and apply wood filler.

Performance Objectives:

Given a selection of various sizes and types of finishing and casing nails, woodwork to be installed, nail sets and a hammer, the student will set the nails to receive wood filler and apply the proper filler.

Evaluation Criterion:

The student will set nails with nail set and hammer to the required depth for wood filler to the satisfaction of the instructor.

Performance Guide:

1. Select the appropriate type and size of finishing or casing nail.
2. Drive and set nails to the required depth:
   a. Set the nail about 1/16" below the surface of the wood.
   b. There will be no hammer marks on the surface of the wood.
3. Fill the recess with the required filler materials:
   a. All sets must receive and hold the filler flush with the surface of the wood with no visual cracks in the wood around the set.
   b. The filler must correspond with the wood texture and finish color. (This does not apply if the surface is to be painted.)
4. Remove excess filler by sanding lightly if the surface is to be finished.

DUTY: MAINTENANCE CARPENTRY - HAND AND POWER TOOLS

TASK: Service and maintain portable woodworking power tools.

Performance Objectives:

Given a portable electric circular saw, a portable saber saw, a portable router, a portable sander and a portable electric drill, the student will service and maintain according to the manufacturer's specifications.

Evaluation Criterion:

The student will service and keep the portable power tools properly maintained to the satisfaction of the instructor.

Performance Guide:

Care of portable electric circular saw; saber saw; and router:

1. Keep the saw blade sharp.
2. Check the gear reduction unit for a periodic lubrication.
3. Coat the steel part with oil film to prevent rusting when not in use.
4. Take care when handling the conductor cord to avoid the cable breaks.

Care of portable electric sander:

1. Replace all the worn or torn sanding paper.
2. Maintain the oil reservoir on the belt sander.
3. Keep the pressure pac in good working condition and secure.
4. Take care when handling the conductor cord to avoid the cable breaks.

Care of portable electric drill:

1. Keep the jaws clean and oiled.
2. Keep the drill bits sharp.
3. Coat the steel parts with oil film when not in use.
4. Care of the chuck key.

UNIT XII. CARPENTRY - INTERIOR FINISH

Tasks Covered:

1. Apply finishes.
2. Fit and hang interior doors.
3. Install dry-wall boards.
4. Install metal corners for dry wall.
5. Install entrance and interior door lock sets.
6. Trim interior door openings.

DUTY: MAINTENANCE CARPENTRY - INTERIOR FINISH

TASK: Apply finishes.

Performance Objectives:

Given interior surfaces prepared for finishing, flat wall paint, shellac, varnish, enamel, brushes, thinners and instructions, the student will prepare and apply finish to the surface.

Evaluation Criterion:

The student will apply finish to the surface to the satisfaction of the instructor.

Performance Guide:

1. Check out the materials from the stockroom following the correct procedures.
2. Mix finishes in accordance with specifications.
3. Select the brushes applicable to each type of finish and surface.
4. Apply finishes with the grain of the wood where applicable.
5. Brush out visible runs and bubbles (fisheyes).
6. Avoid visible overlapping and bonding.
7. Finish all surfaces smooth with no visible lumps and brush drag.
8. Check for missed areas and bad overlap.
9. Clean brushes.
10. Return the supplies to the storeroom.
11. Have the instructor check the finish.

DUTY: MAINTENANCE CARPENTRY - INTERIOR FINISH

TASK: Fit and hang interior doors.

Performance Objectives:

Given a framed door opening, a door, hinges, the necessary tools and equipment, and specifications, the student will fit and hang the door as specified.

Evaluation Criterion:

The student will hang the door to the satisfaction of the instructor.

Performance Guide:

1. Refer to the plans and select a correct door for opening.
2. Lay door on saw horse and remove lugs or horns with a crosscut saw. If the door is bowed, cupped side should fit against rabbet or stops.
3. Place the door in the opening and mark from the inside the exact size of the opening on the door.
4. An equal amount should be removed from each side of the door to fit into the opening. Plane the butt side of the door until the edge of the door fits exactly against the frame.
5. Allow 1/16" clearance on the lock side of the door with the butt of the door tight against frame.
6. Plane the top of the door to fit the frame.
7. Allow 1/8" clearance at the bottom of the door above floor. The clearance at the bottom will depend on the type of the floor covering and door can be cut later.
8. Wedge the door in position allowing 1/16" clearance on the top and the lock side of the door.
9. Measure about 7" down from the top of the door and set a butt hinge at this point. Mark the length of the hinge on the jamb and the door.
10. Repeat Step 9 procedure on the bottom of the door measuring from the bottom of the door about 8" to 10".
11. Chisel out the hinge seat so that the face of hinge

Performance Guide (cont.):

will be flush with the surface of wood.

12. Remove the pin from the hinge; fasten one half to the door; fasten the other half to the jamb.
13. Do not insert all screws in the hinge until all the adjustments are made.
14. Place the door in position; insert the screws in the jamb; adjust the hinges for a proper door fit.
15. Using a plane, plane the edge of the door to fit into the frame, allowing 1/16" clearance on lock side.
16. The lock may be installed 36" to 42" above the floor. Directions for installing the lock set are included in the manufacturer's instructions.
17. Install the lock in the door and the strike in the jamb.
18. Check the door for a proper fit and make adjustments if necessary.
19. Have the instructor check on the door.

DUTY: MAINTENANCE CARPENTRY - INTERIOR FINISH

TASK: Install dry-wall boards.

Performance Objectives:

Given a room ready to receive dry-wall boards, appropriate materials, fasteners, tools and equipment necessary and the specifications, the student will install dry-wall boards to the specifications.

Evaluation Criterion:

The student will install dry-wall boards to the ceiling and the walls as specified to the satisfaction of the instructor.

Performance Guide:

1. Check plans and specifications to determine the size and the thickness of dry-wall boards.
2. Check to make sure studs and ceiling joists are straight and true.
3. Install the backing at ceiling and corners.
4. Measure and cut the dry-wall board to the length and width for the ceiling.
5. Make cutouts for electrical boxes. Cutouts should not be more than 1/8" greater than outside dimensions of the box.
6. Nail dry wall to the ceiling approximately every 7" on the joists:
    a. The lengthwise joints of the sheet will fall along the center of the ceiling joist ± 1/16".
    b. Nails should be driven slightly below the surface of the dry wall.
7. Place the dry-wall boards to the walls lengthwise beginning at the ceiling.
8. Follow the same procedure as used in measuring, cutting and installing the dry wall to the ceiling.
9. Have the instructor check your installation.

DUTY: MAINTENANCE CARPENTRY - INTERIOR FINISH

TASK: Install metal corners for dry wall.

Performance Objectives:

Given a room with wallboard installed, metal corners with fasteners and manufacturer's instructions, tools and equipment, the student will install the metal corners.

Evaluation Criterion:

The student will install the metal corners according to the manufacturer's instructions.

Performance Guide:

1. Align the metal corners properly from the floor to the ceiling.
2. Fasten the metal corners as specified.
3. Have the instructor check your work.

DUTY: MAINTENANCE CARPENTRY - INTERIOR FINISH

TASK: Install entrance and interior door lock sets.

Performance Objectives:

Given the specification, a door that has been hung, cylindrical lockset with manufacturer's instructions, and tools and equipment necessary, the student will install the lockset as specified.

Evaluation Criterion:

The student will install the lock in the door as specified in the manufacturer's instructions.

Performance Guide:

Locate the center:

1. Check the plans and manufacturer's instructions.
2. Open the door to the convenient position and block with wedge.
3. Using a template, locate the hole for the knob and latch case:
   a. The distance from the floor to the center of the knob is usually 34" to 36".
   b. The distance from the side edge of door is usually 2 3/4".
4. Select a proper bit, and bore through the face of the door: Use a scrap wood to prevent drill from splitting wood.
5. Locate the center of the hole on the edge of the door with template.
6. Select a proper bit and bore from the edge of the door to house the latchtail. The hole for the latchtail will be the proper size and in the correct location.
7. Insert latchtail.
8. Mark with knife the outline of the latch front for size of gain.
9. Remove waste with chisel or router to the depth equal to the thickness of the latch front.

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DUTY: MAINTENANCE CARPENTRY - INTERIOR FINISH

TASK: Install entrance and interior door lock sets.

Performance Guide (cont.):

Locate and install strike plate:

1. Measure and locate a center line for the strike plate.
2. Mark the top and bottom edge of the gain for the strike plate.
3. Place the strike plate in position and mark around the perimeter with knife.
4. Remove stock with chisel or router to the depth equal to the thickness of the plate.
5. Fasten the strike plate into position with screws.
6. Install the lockset in the door according to the manufacturer's instructions.

DUTY: MAINTENANCE CARPENTRY - INTERIOR FINISH

TASK: Trim interior door openings.

Performance Objectives:

Given an installed interior door trim (casing), door stop, specifications, tools and equipment, the student will install the door trim and door stops according to the specifications.

Evaluation Criterion:

The student will install the door trims to the specifications.

Performance Guide:

Casings:

1. Check the specifications.
2. Select a straight casing stock; lay off to the lengths for side and head casing. Allow enough material to make joints.
3. Cut the bottom of the side casing square.
4. Gage a light pencil line on the edge of the jambs 1/4' back from the jamb.
5. Mark a point 1/4" above the bottom face of the head jamb on the gaged line. This point is the length of the short end of the mitered stock.
6. Hold the casing in position and mark for the miter cut.
7. Cut the miters.
8. Nail the side casings temporarily in place. Line up with the marks.
9. Measure and cut the head casings to fit the side casings.
10. Nail the casings permanently in place with appropriate nails.

Door stops:

1. Locate the stop on the hinge side of the jamb with a clearance of 1/16" from the door in a closed position.
2. Locate the stop on the lock side of the door tight against the door.
3. Line up the head jambs with the side jambs. (Mitered joints)

DUTY: MAINTENANCE CARPENTRY - INTERIOR FINISH

TASK: Trim interior door openings.

Performance Guide (cont.):

4. Attach the stops to jambs with 4d nails spaced 16" on the center.

MAINTENANCE MECHANICS

UNIT XIII. CARPENTRY - ROUGH FRAMING

Tasks Covered:

1. Build saw horses.
2. Align and brace a wall from corner to corner.
3. Apply subbases over subfloors.
4. Build corner posts.
5. Frame exterior wall.
6. Frame and align a partition wall.
7. Frame and install a built-up "T" sill.
8. Frame and install box sills.
9. Frame built-up girders.
10. Frame floor opening. (Theory only)
11. Frame a wall opening.
12. Identify framing members. (Theory only)
13. Cut and install ceiling (frame) joists. (Theory only)
14. Install diagonal bracing.
15. Install firestops. (Theory only)
16. Install floor joists.
17. Install sill plates to foundation wall.
18. Install post and beam framing. (Theory only)
19. Install structural sheathing.
20. Lay subfloors.

DUTY: MAINTENANCE CARPENTRY - ROUGH FRAMING

TASK: Build saw horses.

Performance Objectives:

Given the basic carpenter's tools necessary, lumber and nails, the student will design and build two saw horses that meet the standard requirements for safety and use.

Evaluation Criterion:

The student will build two saw horses to the satisfaction of the instructor.

Performance Guide:

1. Determine the finished size of saw horses: Length, width, and height (the height must be designed for the working comfort within ± 1").
2. Determine the design desired: Fixed or adjustable.
3. Cut the material to the shape and size according to design.
4. Assemble and fasten parts:
    a. All joints must be adequately nailed for the maximum strength.
    b. All legs must be adequately braced, set at required angles and level with the floor.
5. Check the accuracy of construction.

DUTY: MAINTENANCE CARPENTRY - ROUGH FRAMING

TASK: Align and brace a wall from corner to corner.

Performance Objectives:

Given two wall sections intersecting at a corner, a drawing, a straight edge, level, spacing blocks, line, bracing materials, nails and hammer, and helper, the student will align and brace the wall from corner to corner.

Evaluation Criterion:

The student will plumb and align the wall sections to the satisfaction of the instructor.

Performance Guide:

1. Plumb and brace both ends of the wall:
   a. Wall will be plumb (± 1/16").
   b. Wall will be straight (± 1/16").
   c. Walls will be securely braced.
2. Obtain a line and three blocks equal in thickness.
3. Tack the two blocks at the opposite ends of the plate.
4. Draw line taut over these two blocks.
5. Take a third block and place under the string at spaced intervals along the plate to check the alignment.
6. Adjust and secure the braces when plate is in alignment.
7. Leave braces in place until ceiling joists and sheathing have been nailed in place.
8. Have the instructor check your work.

DUTY: MAINTENANCE CARPENTRY - ROUGH FRAMING

TASK: Apply subbases over subfloors.

Performance Objectives:

Given appropriate materials, tools, equipment and specifications, the student will apply the subbase to the subfloor material.

Evaluation Criterion:

The student will complete the task to the satisfaction of the instructor.

Performance Guide:

1. Clean the subfloor of all debris.
2. Fill cracks and/or joints and sand flush with floor:
   a. The subfloor must be clean and even.
   b. Filled cracks and joints must be firm and sanded level.
3. Check the subbase material for thickness. Select an appropriate type and size of nail.
4. Apply the subbase material.
5. Space nails a maximum of 6".
6. All end joints must be made on a floor joist.
7. Stagger the end joints.
8. Have the instructor check your work.

DUTY: MAINTENANCE CARPENTRY - ROUGH FRAMING

TASK: Build corner posts.

Performance Objectives:

Given the necessary tools, instructions, framing lumber and nails, the student will build a corner post.

Evaluation Criterion:

The student will construct a corner post to the satisfaction of the instructor.

Performance Guide:

1. Determine the stud length from elevation drawing of a typical wall section.
2. Select three 2 x 4s for corner posts. The stock should be straight, sound, and as free of knots as possible.
3. Cut the stock to the required length (± 1/16"). Ends of the corner post will be 90° (± 2°) and cut straight.
4. Depending on the type of post specified, three pieces of 2 x 4 blocking may be required.
5. Assemble parts, keeping the ends of 2 x 4s flush (± 1/32"). All blocks or pieces will be nailed according to FHA specifications.
6. The finished post must be straight, free of loose knots, and provide the required backing.
7. Have the instructor check the soundness of your work.

DUTY: MAINTENANCE CARPENTRY - ROUGH FRAMING

TASK: Frame exterior wall.

Performance Objectives:

Given a previously built foundation, working drawings and specifications, the necessary framing lumber and carpenter's tools, the student will lay out, frame, and align a section of an exterior wall that includes a window and door opening and an interior partition.

Evaluation Criterion:

The student will frame an exterior wall of a typical residential structure to the FHA standards.

Performance Guide:

1. Check the plan for structural details.
2. Determine the function of the wall: Bearing or nonbearing.
3. From the floor plan, establish the sequence of assembly.
4. Lay out the bottom and top plates.
5. Move the top plate back on the subfloor.
6. Lay on the subfloor one stud for each regular stud as laid out on the bottom plate.
7. Nail the top and bottom plates to ends of regular studs:
   a. Be sure to watch layout marks and nail studs on the correct side.
   b. Use two 16d common nails in each end of stud.
8. Place the wall opening assemblies in position and nail to the top and bottom plates.
9. Place and nail the corner and the intersecting partition posts to plate.
10. Have the instructor check the soundness of your work.

DUTY: MAINTENANCE CARPENTRY - ROUGH FRAMING

TASK: Frame and align a partition wall.

Performance Objectives:

Given a helper, a set of working drawings with framing details, and necessary framing lumber and tools, the student will frame and align a partition wall.

Evaluation Criterion:

The student will frame, erect, and secure a partition wall to the satisfaction of the instructor.

Performance Guide:

1. Check the plan.
2. Determine the function of the wall: Interior bearing or nonbearing.
3. From the floor plan, establish the sequence of assembly.
4. Lay out the bottom and top plates.
5. Build up the type of interior corner post needed.
6. Lay out and frame the headers needed over the openings.
7. Assemble, raise, fasten and temporarily brace the wall.
   a. Wall will be plumb ($\pm 2^{o}$).
   b. Wall will be of the specified length (± 1/16").
   c. Studs will be correctly positioned and nailed.
   d. Walls will be straight (± 1/16") and properly secured.
8. Have the instructor check the soundness of your structure.

DUTY: MAINTENANCE CARPENTRY - ROUGH FRAMING

TASK: Frame and install a built-up "T" sill.

Performance Objectives:

Given the working drawings and specifications, a foundation wall with sill plate anchored, necessary tools, equipment and materials, the student will construct a built-up "T" sill.

Evaluation Criterion:

The student will construct a built-up "T" sill as specified.

Performance Guide:

1. Check plans and specifications.
2. Cut the sill header to the correct length: (± 1/16"). Cut the end of the sill header square.
3. Center the sill header on the sill plate: (± 1/8").
4. Spike the sill header to the end of the floor joist.
5. Install straps as required.
6. Have the instructor check the soundness of your work.

DUTY: MAINTENANCE CARPENTRY - ROUGH FRAMING

TASK: Frame and install box sills.

Performance Objectives:

Given working drawings and specifications, a foundation wall with anchor bolts, necessary tools, equipment and materials, the student will construct a box sill.

Evaluation Criterion:

The student will construct a box sill to the specifications.

Performance Guide:

1. Check plans and specifications.
2. Lay out the sill from the plans.
3. Install the sill plate on the foundation wall.
4. Lay out the sill header from the plan.
5. Cut the sill header to the correct length: (± 1/16"). Cut the end of the sill header square.
6. Position the sill header at the outer edge on the top of the sill plate.
7. Fasten the sill header to the end of the floor joists.
8. Have the instructor check the accuracy of your work.

DUTY: MAINTENANCE CARPENTRY - ROUGH FRAMING

TASK: Frame built-up girders.

Performance Objectives:

Given working drawings and specifications, the necessary tools, equipment and material, the student will frame a built-up girder.

Evaluation Criterion:

The student will construct a built-up girder according to the FHA specifications.

Performance Guide:

1. Select straight lumber, free from knots or other defects.
2. Use a long length of stock so that no more than one joint will occur in the span between the bearing points.
3. If 2" x 10" x 16' planks are used:
   a. Cut one plank 8'.
   b. Move the crowned edge of the plank.
   c. Place this edge at the top of the girder.
4. Nail one 16' and one 8' plank together:
   a. Place two 20d nails about 6" from the end of the plank and about 2" from the top and bottom.
   b. Drive them at an angle of about 10° into the two planks.
   c. Do not drive them home so that the points protrude, as this will make it difficult to place the third plank on the girder.
   d. Stagger the nails about 32" apart over the entire length of the girder, working from the end and keeping the top edges of the plank flush with one another as they are fastened.
5. Stagger the joints in the beam as required. Make sure the planks are square at each joint and butted tightly together.
6. After fastening the first two members of the beam, place the third member against the side of the girder opposite that from which the nails are drawn. Make sure the crown is at the top.

DUTY: MAINTENANCE CARPENTRY - ROUGH FRAMING

TASK: Frame built-up girders.

Performance Guide: (cont.)

7. Nail the third member solidly. Just like the first, drive all nails home.
8. Have the instructor check the soundness of your girder.

DUTY: MAINTENANCE CARPENTRY - ROUGH FRAMING

TASK: Frame floor opening. (Theory only)

Performance Objectives:

Given a lecture presentation, working drawings, and FHA specifications for the floor openings, the student will demonstrate his knowledge of the proper selection of the necessary materials, tools and equipment as well as the requirements to be met in framing floor openings.

Evaluation Criterion:

The student will explain, to the satisfaction of the instructor, the selection of materials, tools and equipment necessary for the job and the procedures.

Performance Guide:

1. Determine the size and location of the floor opening according to the plan.
2. Locate the width of the openings on girders and sill. Opening must be square.
3. Select sound and straight joists for trimmers.
4. Cut the trimmers for a correct length.
5. Install the trimmers, keeping the crown up. Distance between trimmers should be equal to the required rough opening.
6. Mark the length of opening on the trimmers.
7. Select the material for the headers that is clear, straight and sound.
8. Determine the length of header and cut the material.
9. Spike the headers into place. Joist hangers may also be used at this point.
10. Headers should then be doubled spiking through trimmer into doubled header, and also spiking through doubled header into header.
11. Trimmers should then be doubled or tripled according to the floor plans or specifications.
12. Tail joists length must be determined.

DUTY: MAINTENANCE CARPENTRY - ROUGH FRAMING

TASK: Frame floor opening. (Theory only)

Performance Guide: (cont.)

13. Headers must be laid out for tail joists to maintain proper joist spacing.
14. Tail joists must be cut and installed. Joist hangers may be used to frame tail joists to doubled header.

DUTY: MAINTENANCE CARPENTRY - ROUGH FRAMING

TASK: Frame a wall opening.

Performance Objectives:

Given working drawings and specifications, necessary tools, equipment and materials, the student will frame a wall opening.

Evaluation Criterion:

The student will frame a wall opening to FHA specifications.

Performance Guide:

1. Install full studs on each side of the opening.
2. Install the built-up header plumb and level.
3. Cut and install trimmers.
   NOTE: At this point, a door opening will be complete.
4. Cut, lay out and install the rough window sill to the exact dimensions (± 1/16").
5. Install the cripple studs.
6. All the framing members will be flush (± 1/16").
7. Have the instructor check your work.

DUTY: MAINTENANCE CARPENTRY - ROUGH FRAMING

TASK: Identify framing members. (Theory only)

Performance Objectives:

Given drawings of floor and sill members, wall framing members and roofing members, and list of names for framing members, the student will identify all the framing members shown on the drawings, and describe the function of those framing members.

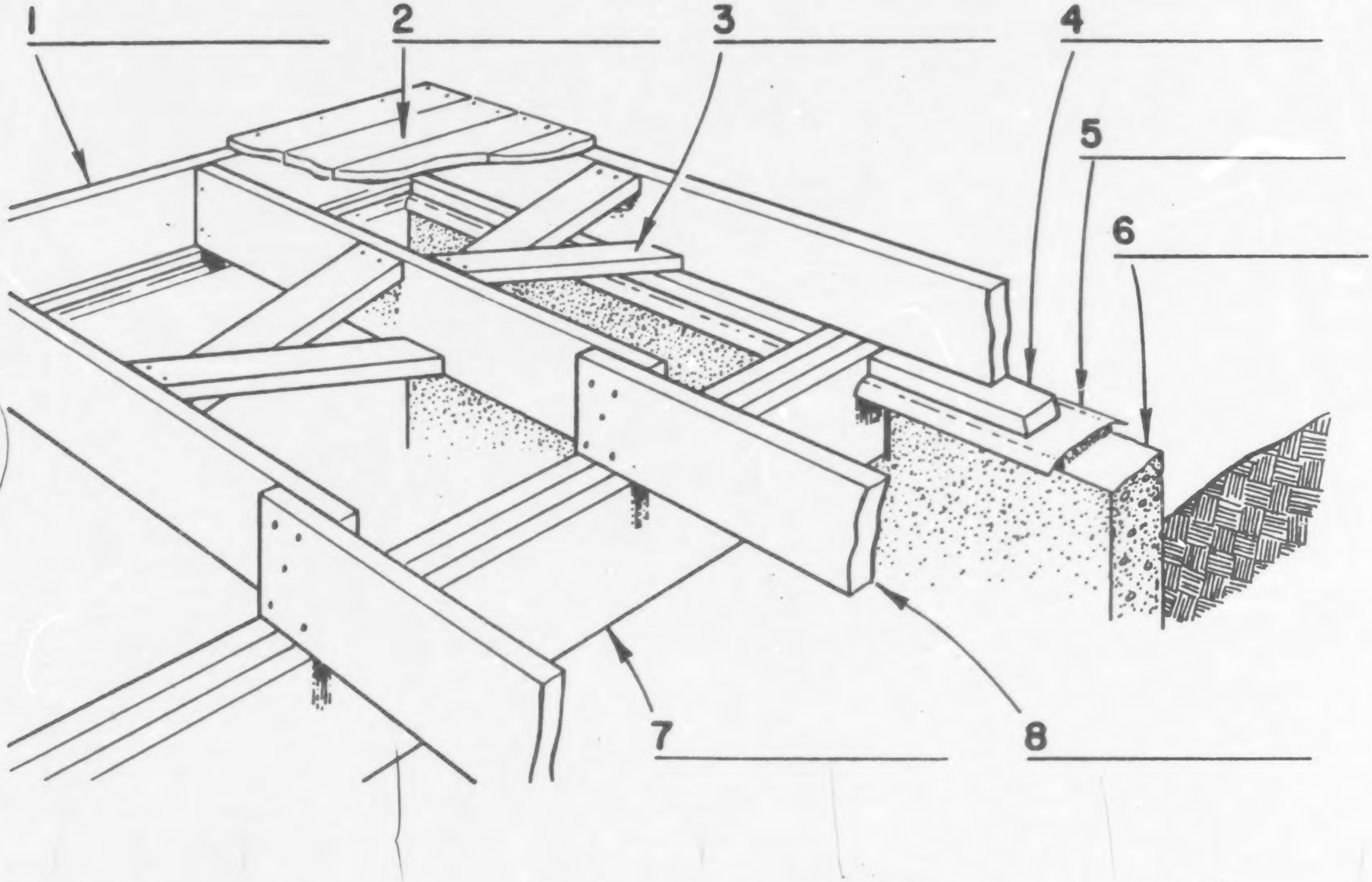
Evaluation Criterion:

The student will identify and describe the function of the framing members to the satisfaction of the instructor.

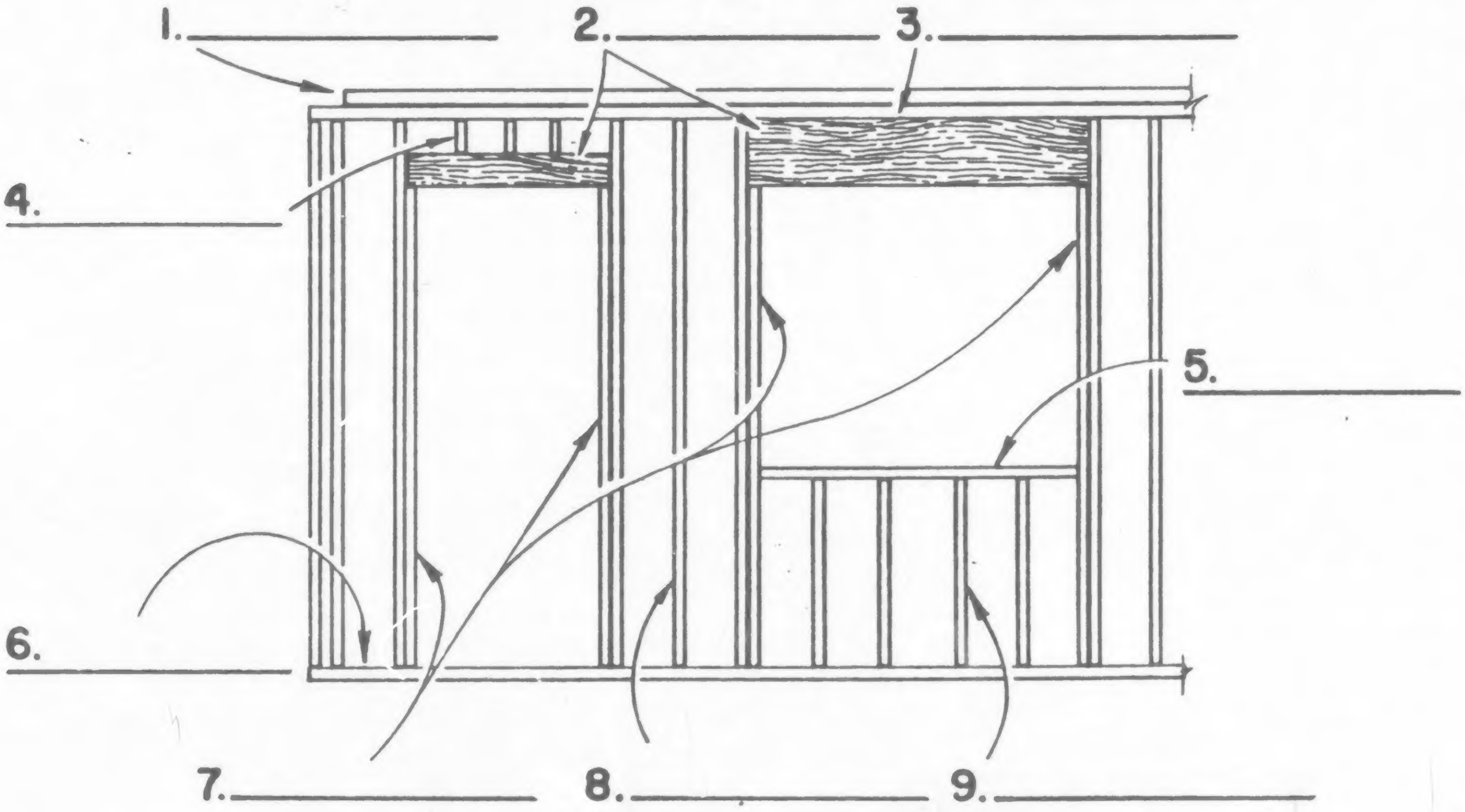
Performance Guide:

1. Identify each of the framing members on the drawing with the matching name on the list.
2. Describe correctly the function of each of the framing members.

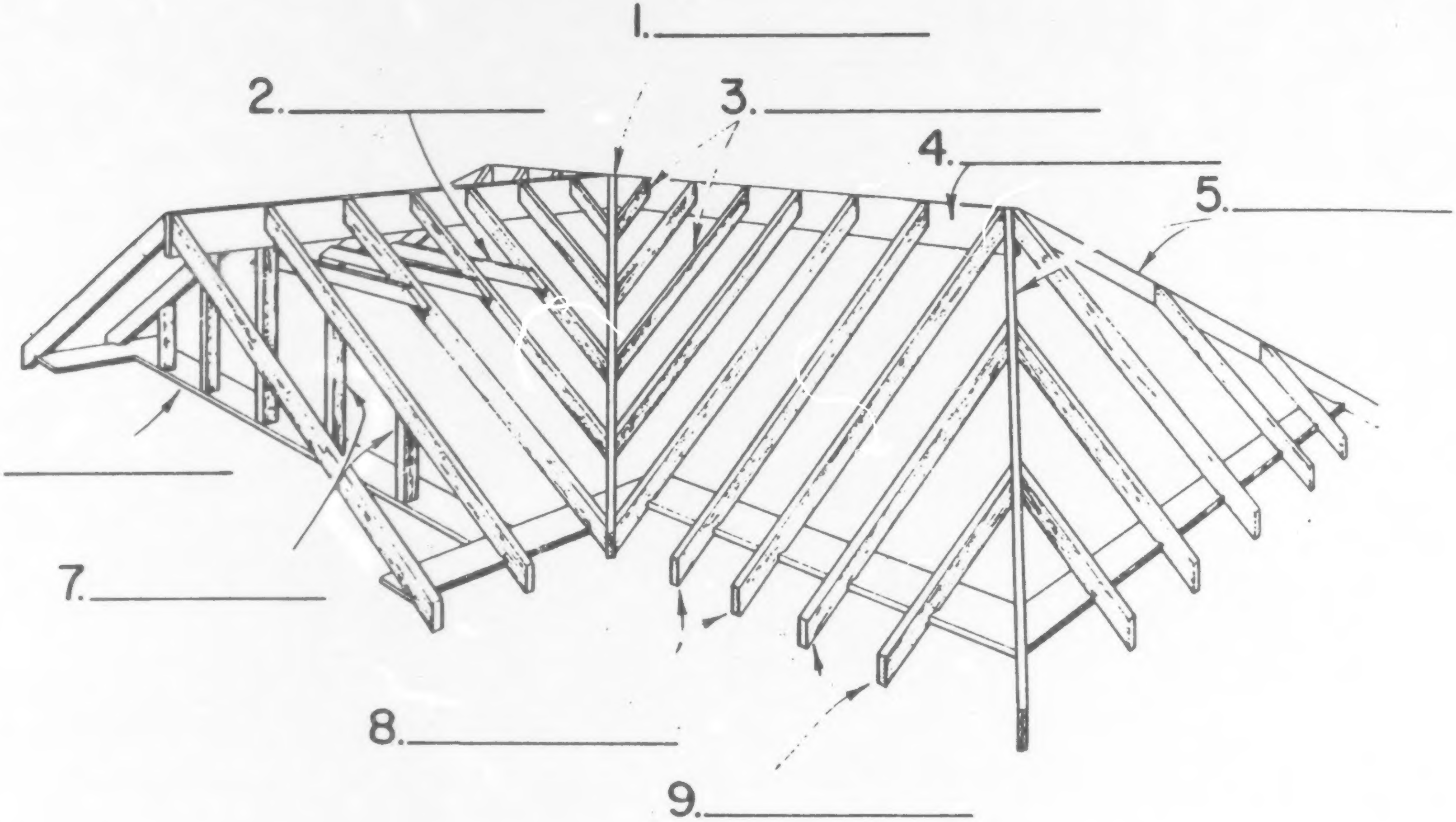
FLOOR AND SILL MEMBERS



WALL FRAMING MEMBERS



ROOFING MEMBERS



MAINTENANCE CARPENTRY:	Names of Framing Members
Floor and Sill Member:	built-up girder
	cross bridging
	flashing
	floor joist
	foundation
	sill header
	sill plate
	subfloor
Roofing Members:	collar brace
	common rafter
	eave studs
	hip jack
	hip rafter
	[illegible]e board
	valley jacks
	valley rafter
	wall plate
Wall Framing Members:	cripple (tail stud)
	headers
	jack or jamb stud
	lower wall plate
	sill
	sole plate
	tail stud

MAINTENANCE CARPENTRY: Names of Framing Members

Wall Framing Members: (continued)

upper wall plate

wall stud

DUTY: MAINTENANCE CARPENTRY - ROUGH FRAMING

TASK: Cut and install ceiling (frame) joists. (Theory only)

Performance Objectives:

Given a lecture presentation, drawings and specifications, the student will identify the necessary tools, equipment and materials, and installation of the ceiling joist.

Evaluation Criterion:

The student will demonstrate his knowledge on the installation of the ceiling joist to the satisfaction of the instructor.

Performance Guide:

Know the proper steps and the standard requirements for the installation of the ceiling joist:

1. Check the plan to determine the joist span and the spacing of the joists. Joists should not extend beyond the size of the building.
2. Lay out and mark joist.
3. Cut joists to the length (± 3/16").
4. Lay out and mark distances between joists on the wall plates.
5. Place joists on the spacing marks.
6. Check to see that the crown of each joist is turned up.
7. Check to see that joists are on the same side of the spacing mark.
8. Nail the joists in place according to FHA specifications.
9. Install the walk boards if required.

DUTY: MAINTENANCE CARPENTRY - ROUGH FRAMING

TASK: Install diagonal bracing.

Performance Objectives:

Given drawings and specifications, necessary tools, equipment and materials, the student will cut and install a diagonal bracing in the wall structure.

Evaluation Criterion:

The student will brace the wall with let-in or diagonal brace to the satisfaction of the instructor.

Performance Guide:

1. Straighten, square, and secure the wall section in place.
2. Determine the placement of the brace.
3. Cut to the required length (± 1/8").
4. Tack the brace in position and mark the layout on each stud.
5. Remove the brace and gauge the depth of the cut so that the brace will fit flush with studs.
6. Make side-cuts with saw, and remove the wood between the cuts with a chisel.
7. Put the brace in position. Check for the accuracy.
8. Make the correction if necessary.
9. Nail the brace in place.
10. Have the instructor check your work.

DUTY: MAINTENANCE CARPENTRY - ROUGH FRAMING

TASK: Install firestops. (Theory only)

Performance Objectives:

Given a lecture presentation, the student will identify the necessary tools, equipment and materials, and explain the procedural steps and standard requirements for the installation of firestops.

Evaluation Criterion:

The student will demonstrate his knowledge by explaining the necessary supplies and tools as well as the prescribed procedures for the job to the satisfaction of the instructor.

Performance Guide:

Know the following procedures for installing firestops:
1. Box in vital points with 1" boards and fill boxes with noncombustible materials.
2. Cut 2 x 4 blocks between the wall studs.
3. Cut 2 x 8 or 2 x 10 blocking between the floor joists.

Know the requirements for the firestops:
1. Make the firestops the required lengths (± 1/16").
2. Secure the firestops firmly in place.
3. Locate the firestops as specified.

DUTY: MAINTENANCE CARPENTRY - ROUGH FRAMING

TASK: Install floor joists.

Performance Objectives:

Given drawings and specifications, tools, equipment, and material necessary, the student will cut and install floor joists as specified.

Evaluation Criterion:

The student will lay out, cut and install floor joists to the satisfaction of the instructor.

Performance Guide:

1. Check the specifications and plans for the required joists: 2 x 6; 2 x 8; etc.
2. Determine the size needed. Cut the joist to the required length (± 1/16").
3. Lay out the spacing on the sill plate according to the specifications.
4. Check if the crown of joists is turned up.
5. Place the joist in proper position according to layout marks on the sill. Joists will be placed 16" on center (± 1/16").
6. Toenail joists in place with at least four 8d nails. Larger nails may be used - 10d, 12d.
7. Nail joists on the sill header using three No. 16d nails. Check the crown.
8. Straighten joists before installing the bridging.
9. Have the instructor check your work.

DUTY: MAINTENANCE CARPENTRY - ROUGH FRAMING

TASK: Install sill plates on foundation wall.

Performance Objectives:

Given a foundation wall ready to receive the sill plates, necessary tools and equipment, materials, drawings and specifications, the student will cut and install a sill plate at the top of a foundation wall according to specifications.

Evaluation Criterion:

The student will install the sill plates at the top of a foundation wall according to the FHA specifications.

Performance Guide:

1. Anchor bolts should be installed in the foundation walls during construction.
2. Place the sill plates along the top of the four walls in approximately their permanent position:
   a. Use 14' to 16' lengths of stock.
   b. Place the sill so that no joints will occur over the openings in the walls, and square the butt joints.
3. Lay the sill plate against the inside of the anchor bolts. The ends of the sills may be left projecting over the ends of the wall.
4. Square the lines from each anchor bolt across the sill plate.
5. Measure the correct distance along each line from the outside edge of the sill to locate the holes for the anchor bolts.
6. Mark these holes and bore or drill the holes with a bit 3/8" larger than the diameter of the bolt.
7. Place the sill over the anchor bolts.
8. Cut the sill plates square at the corners of the building so that they butt together closely.
9. Place washers and nuts on the anchor bolts and draw the nuts down to bring the sill plates down temporarily to the masonry wall.

DUTY: MAINTENANCE CARPENTRY - ROUGH FRAMING

TASK: Install sill plates on foundation wall.

Performance Guide: (cont.)

10. Square the plate at each corner and brace the sill in this position.
11. If the foundation wall is not level and true, level and straighten the sill over the bearing walls by using a straight edge and level.
12. After the sill plate is level and straight, tighten the nuts on the anchor bolts.
13. Have the instructor check your work.

DUTY: MAINTENANCE CARPENTRY - ROUGH FRAMING

TASK: Install post and beam framing. (Theory only)

Performance Objectives:

Given a lecture presentation, drawings and specifications, the student will demonstrate his understanding of the selection of tools, equipment and materials necessary for the job and the proper procedures for the installation of posts, beams and planking according to the specifications.

Evaluation Criterion:

The student will demonstrate his knowledge by explaining a standard procedure for the job to the satisfaction of the instructor.

Performance Guide:

Study and know the following procedures for installing the post and beam framing.

1. Check drawings for the location of posts in exterior wall.
2. Place posts in position; brace temporarily.
3. Check the post height before securing. The post height should be as specified (± 1/16").
4. Install the perimeter beam.
5. Install all interior beams.
6. Locate and position all interior posts.
7. Check the post height before securing.
8. Cut and install roof planks to beams as specified.

DUTY: MAINTENANCE CARPENTRY - ROUGH FRAMING

TASK: Install structural sheathing.

Performance Objectives:

Given drawings and specifications, necessary tools and equipment and materials, the student will install structural sheathing to FHA specifications.

Evaluation Criterion:

The student will install the sheathing material on the exterior wall as specified by FHA.

Performance Guide:

1. Check FHA and manufacturer's recommendations for the placement of the sheathing.
2. Cut sheathing to length if required.
3. Start the first panel flush with the bottom of sill and at the end of a wall.
4. Position the sheathing, and nail it in place.
    a. Nail the sheathing properly for the type and size of the fasteners used and spacing as recommended by FHA.
    b. Center the joints of the sheathing materials on the studs.
    c. Joints will be tight, the gap not to exceed 1/8".
5. Cut the openings after the sheathing is nailed.

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DUTY: MAINTENANCE CARPENTRY - ROUGH FRAMING

TASK: Lay subfloors.

Performance Objectives:

Given a section of foundation with floor joists, materials, fasteners, and the necessary tools and equipment, the student will cut and nail a section of subflooring at a 45° angle to floor joist according to the FHA specifications.

Evaluation Criterion:

The student will lay out, cut and install the subfloor to the satisfaction of the instructor.

Performance Guide:

1. Starting at the corner, measure five feet out each side and mark.
2. Using chalk line, snap a line between these marks.
3. Put the first board in place, making any joints over a joist.
4. Face-nail the first board two times on each joist.
5. Then put the second board into place.
6. Fit the second board to the first, drawing it tight.
7. Nail the second board and all others twice in each joist.
8. Joint material over top of the joist.
9. Stagger the joints. Lay out joints so that no two successive rows will have the joints on the same joist.
10. Cut end to end joints at 45° angle: All end joints must be tight.
11. Have the instructor check your work.

MAINTENANCE MECHANICS

UNIT XIV. CARPENTRY - ROOFING

Tasks Covered:

1. Apply insulation (underlay) for asphalt shingles.
2. Build roof trusses.
3. Calculate the rise and run of a common roof.
4. Determine length of rafter scale.
5. Flash chimney. (Theory only)
6. Flash valleys for asphalt shingles. (Theory only)
7. Install asphalt composition (strip) shingles.
8. Roof styles. (Theory only)
9. Install and align ridge boards.
10. Install roof sheathing.
11. Lay out, cut and install ceiling joist.
12. Lay out, cut and install common rafters for equal-pitch roofs.
13. Lay out, cut and install common rafters for unequal-pitch roofs.
14. Lay out a common roof plan. (Theory only)
15. Lay out, cut and install cripple jack rafters for hip and valley installations. (Theory only)
16. Lay out, cut and install gable studs. (Theory only)
17. Lay out, cut and install gambrel roof rafters.
18. Lay out, cut and install hip jack rafters for equal-pitch roofs. (Theory only)
19. Lay out, cut and install hip jack rafters. (Theory only)
20. Lay out, cut and install valley rafters for equal-pitch roofs. (Theory only)
21. Lay out wall plates and ridge board to receive rafters.

DUTY: MAINTENANCE CARPENTRY - ROOFING

TASK: Apply insulation (underlay) for asphalt shingles.

Performance Objectives:

Given job specifications, a helper, tools and materials necessary, the student will apply the insulation (underlay felt) to a presheathed roof.

Evaluation Criterion:

The student will apply the insulation to the presheathed roof in accordance with the job specifications.

Performance Guide:

1. Check the job specifications for the type of underlay required.
2. Where the roof contains a valley, install one strip running lengthwise before installing the horizontal strips.
3. Start the bottom and one edge of the roof. If the roof pitch is too steep to work from the roof, a starting scaffold must be elected.
4. Place the roll of felt in position to unroll along the bottom roof line and roll off the first run with the helper holding the strip in position: Cut the felt to the length.
5. Nail or staple the first strip to the sheathing beginning near the center and working toward each end.
   a. Nails (or staples) should be placed close enough together to hold the strip in place.
   b. Edges 8" to 10" and center sections 18" to 24" apart.
6. If there is no lap line on the felt, snap a chalk line 2" from the upper edge for installation line for the bottom edge of the second strip.
7. Install the second and additional strips following Steps 3, 4, and 5 above.
8. If shingles cannot be installed at the time underlay is applied, the roof section should be stripped apart. Nail thin strips of wood vertically, approximately 4' apart.

DUTY: MAINTENANCE CARPENTRY - ROOFING

TASK: Build roof trusses.

Performance Objectives:

Given the necessary information, specifications, tools and materials needed and a helper, the student will build a roof truss to the acceptable standard.

Evaluation Criterion:

The student will build a roof truss with the assistance of the helper to the satisfaction of the instructor.

Performance Guide:

1. Check the specifications for details and dimensions. If the roof pitch and critical dimensions are not given, calculations must be made to determine them.
2. Make a full size layout of the truss on the floor. Snap chalk lines for the three basic members: the two top rafter chords and the bottom joist chord.
3. Determine the plumb and plate cuts for these members.
4. Cut the top and bottom chords and tack them in their position on the layout.
5. Determine the length of the two tension webs.
6. Lay out, cut and position the two compression webs. These webs should start at the top ridge and tie into the bottom chord one-third the distance of the building span.
7. Lay out, cut and position the two compression webs. These webs should run from the bottom tension webs to approximately one-half the length of each top chord.
8. Disassemble and use all of the pieces as patterns to cut the required number of pieces for all of the trusses.
9. Assemble the trusses one at a time. Use the original layout or assemble one truss and use it as a pattern for assembling the remaining members.
10. Use extra clamps on pieces that are bowed to hold them in position until plated or connectors can be installed.

DUTY: MAINTENANCE CARPENTRY - ROOFING

TASK: Build roof trusses.

Performance Guide (cont.):

11. Check each truss for alignment; glue joists and fastener installation, where required, before starting on additional trusses.

DUTY: MAINTENANCE CARPENTRY - ROOFING

TASK: Calculate the rise and run of a common roof.

Performance Objectives:

Given the span of the building (32'6") and the pitch of the roof (1/3 pitch), the student will calculate the run and rise for a common roof.

Evaluation Criterion:

The student will accurately calculate the rise and run for a given roof.

Performance Guide:

1. Calculate the run of the roof (1/2 of the span):
   Run = 1/2 of the Span = 32'6" ÷ 2 = 16'3" = 195"
2. Calculate the pitch (a ratio of a Rise to a Span) into the "inches-rise per foot-run":
   a. Find the total rise of the roof in inches:
      Pitch (1/3) = Rise : Span (32'6" or 390")
      Rise = 390" ÷ 3 = 130"
   b. Divide the total rise in inches by the number of feet in the run of the roof to find the inches rise per foot-run:
      130" ÷ 16.25 = 8" = Unit Rise = inches-rise per foot-run.
3. To determine the total rise of the roof from a given span and the inches-rise per foot-run:
   Multiply "inches-rise per foot-run" by the "number of feet" in the run of the roof.
4. Pitch (1/3) = Unit Rise (8") : Unit Span (24").

DUTY: MAINTENANCE CARPENTRY - ROOFING

TASK: Determine length of rafter scale.

Performance Objectives:

Given the plan of a building, the pitch of the roof and a framing square, the student will determine the length of the rafters by using tables found on the square.

Evaluation Criterion:

The student will accurately determine the rafter lengths for a given house.

Performance Guide:

1. Determine the kinds of rafters needed.
2. Calculate the rise-per-foot-run.
3. Determine the run.
4. Add for overhang: in feet.
5. Multiply the run by the length of common rafter per foot run.
6. Subtract one-half the thickness of the ridgeboard.

Rafter Length = Run x Unit of Length

Run of the building and unit rise are required before the rafter length can be determined.

Common Rafter:
1. Calculate the unit rise for the common rafter.
2. Determine the unit length for common rafter.
3. Multiply the unit figure by the rafter run.

Hip Rafter:
1. Use 17" base for the hip rafter run.
2. Determine the unit length for the actual foot run.
3. Calculate the total length.

Jack Rafters:
1. Determine the difference in the length of the jacks for 16" centers - 24" on center.
2. Calculate the lengths for the successive rafters.

DUTY: MAINTENANCE CARPENTRY - ROOFING

TASK: Flash chimney. (Theory only)

Performance Objectives:

Given a lecture presentation, the student will learn the acceptable procedures to flash a given chimney.

Evaluation Criterion:

The student will demonstrate his understanding of the proper procedures and standard requirements for the chimney flash to the satisfaction of the instructor.

Performance Guide:

Know the following procedures and requirements.
1. If the chimney is 30" or more in width and located on a sloping roof, a chimney saddle (cricket) must be installed on the upper side.
2. Chisel out the mortar joints that will be used to receive the counterflashing cap strips. When a saddle is not installed, the flashing on the upper side of the chimney must extend upward at least 4".
3. Apply the flashing in two parts:
   a. The base part is secured to the roof deck.
   b. The cap flashing is secured to the chimney.
4. For the base flashing, use 90 lbs. mineral surfaced roofing.
5. Cut strips that are 12" to 18" wide and install them around the chimney. Install the front strips first, the side strips second, and the top strip last.
6. Use copper sheathing (or approved sheet metal) for the cap flashing.
   a. Fit a piece in place for each shingle run (or no more than two runs) at the sides of the chimney.
   b. These pieces must extend up the exterior face of the chimney, be inserted between the bricks, and extend under the shingle run (or runs) at least 6".
7. Counterflash at all corners.
8. Drive nails in the mortar joints at the top where flashing is imbedded to hold it in place.
9. Fill the mortar joints where flashing is imbedded with

DUTY: MAINTENANCE CARPENTRY - ROOFING

TASK: Flash chimney. (Theory only)

Performance Guide (cont.):

mortar (or caulk with roof cement that is the same color as bricks).

10. Check the completed work for holes or cracks that could cause leaks. Fill them with roof cement, coating around edges.

DUTY: MAINTENANCE CARPENTRY - ROOFING

TASK: Flash valleys for asphalt shingles. (Theory only)

Performance Objectives:

Given a lecture presentation, the student will learn the acceptable procedures and standard requirements for flashing the valleys for asphalt shingle installation.

Evaluation Criterion:

The student will demonstrate his understanding of the task by his participation in class discussion to the satisfaction of the instructor.

Performance Guide:

Know the following procedures for the job:

1. For asphalt shingles, the recommended flashing material is .019 or heavier aluminum. Other types of materials are approved such as copper and other coated metals.
2. Install the first strip centered in the valley and laid with the mineral surface down.
    a. This strip should be at least 18" wide and nailed with roofing nails, nailing one edge first.
    b. Press the center down and nail the second edge.
3. When necessary to join either of the strips, the lapped joints must overlap a minimum of 8" and be sealed with asphalt cement.
4. Using a chalked builder's line, snap a center line for the layout.
    a. Following the specifications, snap lines on each side of the center line to determine the valley width.
    b. Cut and install the shingles creating the valley.

DUTY: MAINTENANCE CARPENTRY - ROOFING

TASK: Install asphalt composition (strip) shingles.

Performance Objectives:

Given a roof prepared for shingles, a helper, tools and materials necessary, the student will install the asphalt strip shingles.

Evaluation Criterion:

The student will install the asphalt shingles to the satisfaction of the instructor.

Performance Guide:

Know the various types, designs and shapes of composition strip shingles available:

  a. The square-butt three-tab shingles appear to be the most widely used.
  b. The following procedures are for the square-butt three-tab type.

1. Snap the vertical starting lines from the outside edge of cornice trim board for 36" shingles.
2. Lay the first layer with the slot upside down; or cut a starter strip from the solid material that is the same type or color, to avoid the exposed joints and wind breakage. Nail along the bottom edge.
3. Start the second layer over the first starting with a cut shingle that prevents two joints or slots from coinciding.
4. Check the manufacturer's instructions to determine the amount of exposure: e.g., 5" exposed to weather.
5. Measure up from the top of the first layer the amount of exposure and snap a line for the top of the second layer.
6. Start every other layer with a cut shingle to avoid the joints or slots falling in the same position; keep a straight line.
7. Nail each shingle with the number and type of nails specified by the manufacturer.

DUTY: MAINTENANCE CARPENTRY - ROOFING

TASK: Install asphalt composition (strip) shingles.

Performance Guide (cont.):

Avoid having any nails too close to the edges or low enough to be exposed after the next layer is installed.

8. Seal the last tab at the beginning and end of each run (at rake) with asphalt sealer to prevent wind damage during storms. These end run tabs are the most susceptible to damage.
9. All runs should be completed until the entire roof is covered.
10. Install the ridge cap shingles.
11. Have the instructor check your installation.

DUTY: MAINTENANCE CARPENTRY - ROOFING

TASK: Roof styles. (Theory only)

Performance Objectives:

Given a drawing of six types of roof construction, the student will identify all six types of roof construction.

Evaluation Criterion:

The student will correctly identify all six types of roof construction.

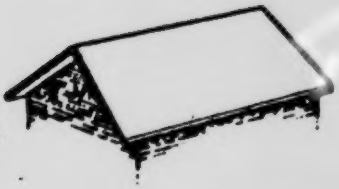
Performance Guide:

1. Study the drawing and the list of names for six different roof types.
2. Match the roof styles with their appropriate names.

ROOF STYLES

NAMES FOR ROOF STYLES

A. FLAT
B. GABLE
C. GAMBREL
D. HIP
E. MANSARD
F. SHED



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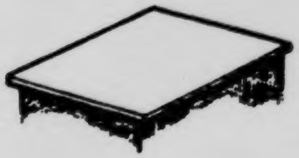

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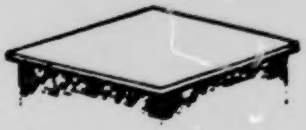

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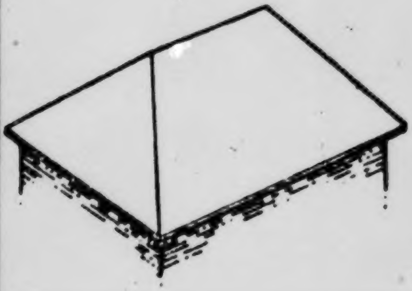

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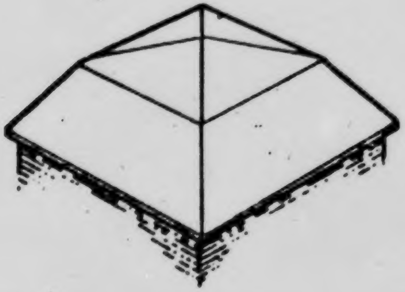

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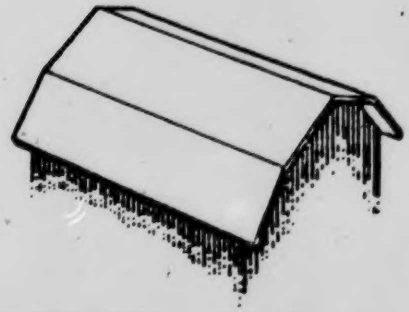

6. ______________

DUTY: MAINTENANCE CARPENTRY - ROOFING

TASK: Install and align ridge boards.

Performance Objectives:

Given a building framed with the wall plates laid out to receive rafters, a helper, instructions and necessary tools and materials, the student will install and align the ridge board including rafter installation.

Evaluation Criterion:

With the aid of the helper, the student will install and align the ridge board including the rafters to the satisfaction of the instructor.

Performance Guide:

Determine the procedures most appropriate to the job circumstances and the conditions:

1. Lay out the ridge board to receive the rafters:
   a. The layout must coincide with the wall plate layouts.
   b. When more than one board is required, the pieces should be joined at the center of a pair of rafters.
2. Place the common rafters at their respective position coinciding exactly with the wall plate markings.
3. Nail the top of the end common rafter flush with the outside wall plate.
4. Nail the top of a second rafter at the opposite end of the ridge board, or flush with the end of the ridge where ridge extends to the opposite wall plate.
5. Cut the uprights to assist in holding the ridge board temporarily in working position.
6. Raise the ridge and the top ends of the two support rafters up to the position temporarily resting on the upright.
7. Install the two rafters opposite the first pair to support this section of the ridge in position.
8. Install the remaining rafters in pairs nailing the seat of each rafter first then finally nailing to ridge.
9. Check the alignment of the end of ridge to corresponding wall plates by plumbing down to the outside edge of the wall.

DUTY: MAINTENANCE CARPENTRY - ROOFING

TASK: Install and align ridge boards.

Performance Guide (cont.):

10. Install one diagonal brace at each end of ridge to hold ridge and rafters in the aligned position.
11. Have the instructor check your work.

DUTY: MAINTENANCE CARPENTRY - ROOFING

TASK: Install roof sheathing.

Performance Objectives:

Given a frame and roof, necessary tools and materials and a helper, the student will cut and install the roof sheathing.

Evaluation Criterion:

The student will cut and install the roof sheathing to the satisfaction of the instructor.

Performance Guide:

1. Know that sheathing should be wide and thick enough to span between rafters providing a good solid base to hold nails and support the roof load.
2. Know that plywood is the most versatile and commonly used due to the labor cost.
3. The following are the guides for plywood sheathing:
   a. Lay out and snap a chalk line 4" to 6" from the bottom end of the rafters at each end of the building.
   b. Lay the first run of panels' top edges to this line with face grain perpendicular to the rafters to establish a perfectly straight cornice line and assure the maximum strength.
   c. Center the end of the joints in the middle of the rafters and face-nail the first row to each joist. Space nail 6" at edges and 12" in centers and intermediate supports.
   d. Install the second row of panels the length of the roof.
   Stagger the joints on the different rafters. This can be accomplished by starting with 1/2 of a sheet.
   e. Repeat these processes for each remaining run required to cover the roof.
   f. Check the entire roof for any irregularities or sections that have been nailed.
4. Have the instructor check your work.

DUTY: MAINTENANCE CARPENTRY - ROOFING

TASK: Lay out, cut and install ceiling joist.

Performance Objectives:

Given a structure with the bearing walls erected ready to receive the ceiling joist, a helper, tools and materials necessary, the student will lay out, cut and install the ceiling joist.

Evaluation Criterion:

The student will lay out, cut and install the ceiling joist to the satisfaction of the instructor.

Performance Guide:

1. Lay out the top plate to receive the ceiling joist. Do this at the same time when the bottom wall plate is marked for the wall studs.
2. Space the joist 16 o.c. (on-center) unless specifications indicate otherwise.
3. The rafters should rest directly over the outside wall studs when possible and the joist adjacent to the roof rafters for strength.
4. Lay out the interior bearing walls to receive the joists.
5. Check for the crown of the joist and cut away the portion of the joist that extends above the rafter line.
6. Place the required joists on the top of the wall plates adjacent to their nailing positions.
7. Nail the outside ends of joists flush with the outside of top plate with each joist overlapping inside bearing partition wall.
   Install each joist with the crown up.
8. Brace the inside center bearing wall for the final alignment and installation.
9. Use a builder's line with alignment block gauges to line up the outside wall plates as the joists are systematically nailed to the inside bearing wall plate.
10. When the outside plates are aligned, nail the joist to the inside bearing wall plates.

DUTY: MAINTENANCE CARPENTRY - ROOFING

TASK: Lay out, cut and install ceiling joist.

Performance Guide (cont.):

11. Check all outside plates for alignment and nail the overlapped joist securely.
12. Have the instructor check your work.

DUTY: MAINTENANCE CARPENTRY - ROOFING

TASK: Lay out, cut and install common rafters for equal-pitch roofs.

Performance Objectives:

Given drawings and specifications including roof layout, necessary tools and materials and helper, the student will lay out, cut and install common rafters for an equal-pitch roof.

Evaluation Criterion:

The student will lay out, cut and install the common rafters for an equal-pitch roof to the satisfaction of the instructor.

Performance Guide:

1. Check the prints for instructions such as roof pitch, on-center layout for installation, etc.
2. Determine the span of the building and divide by two to establish the run of the common rafters.
3. Calculate the total length of rafter from the plate to the ridge.
4. Determine the steel square setting for the vertical (plumb) and horizontal (plate) cuts.
   Plumb cuts will be the rise figures, and horizontal cuts will be the run figures.
5. Select a straight board to lay out and make the "marking" pattern rafters.
6. Lay out the vertical (plumb) cut on the top end of the pattern rafter.
7. Establish a layout line and work from this line to locate the plumb cut for the bird's mouth (seat) of rafter.
8. Measure the total length to the corresponding vertical plate line, and mark the plumb cut line for the bird's mouth (seat) cut.
   Deduct the one-half vertical thickness of ridge board from the overall length.
9. Establish the depth of the seat (bird's mouth) and mark for the horizontal cut on the 12 (or run) side

DUTY: MAINTENANCE CARPENTRY - ROOFING

TASK: Lay out, cut and install common rafters for equal-pitch roofs.

Performance Guide (cont.):

of setting.

10. Determine the total amount of the overhang or tail section of the rafter. Make the corresponding layout on the tail section for the type of cornice required.
11. Carefully check all calculations and layouts for accuracy.
12. Make the required cuts on the pattern rafter.
13. Select the required number of common rafters and stack them with the crown (bow) in corresponding positions.
14. Place the pattern on each rafter with the crown up and mark the required cuts on each rafter.
15. Make the required cut square with the side of each rafter.
16. Lay out the ridge board and side wall plates the designated distance on centers.
17. Erect the rafters in pairs starting with the gable rafters, or at the apex of the first pair of hipped rafters, if it is a hipped roof.
18. Plumb the gable rafters (or the first pair of common rafters on a hipped roof). For gable roofs the end of the ridge should be flush with the outside of the rafters and the corresponding wall plate.
19. Erect the remaining rafters in pairs, first one rafter and then the opposite, nailing the bottom ends of the rafters to the plate first.
20. Check all of the rafters for proper nailing, alignment and installation.
21. Have the instructor check your work.

DUTY: MAINTENANCE CARPENTRY - ROOFING

TASK: Lay out, cut and install common rafters for unequal-pitch roofs. (Theory only)

Performance Objectives:

Given a lecture presentation and specifications for the building, the student will learn the acceptable procedures for layout, cutting and installation of the common rafters for the unequal-pitch roof.

Evaluation Criterion:

The student will demonstrate his understanding on the proper steps to follow in the layouts and installation of common rafters for the unequal-pitch roof to the satisfaction of the instructor.

Performance Guide:

Know the following procedures for the job:

1. Check the drawings for the designated pitch for each section of the roof, (major and minor) or the established height of ridge roof line.
2. If the pitch is not given, lay out to scale the rectangular roof outlines to locate the ridge dividing the major and minor sections. Then calculate to determine the pitch: Pitch = Total rise : Total span.
3. Calculate the length of a common rafter for the pitch for each section.
4. Lay out, cut and install the common rafters for each section.

DUTY: MAINTENANCE CARPENTRY

TASK: Lay out a common roof plan. (Theory only)

Performance Objectives:

Given a lecture presentation, and overall dimensions of a floor plan, the student will learn to lay out the roof plans for a hip roof construction on a 4/12 pitch.

Evaluation Criterion:

The student will lay out a common roof plan to the satisfaction of the instructor.

Performance Guide:

1. Check the floor plan to determine all the necessary dimensions for the roof plan.
2. Lay out a common roof plan.
3. All framing members must be accurately located showing the on center (o.c.) layout.

DUTY: MAINTENANCE CARPENTRY - ROOFING

TASK: Lay out, cut and install cripple jack rafters for hip and valley installations. (Theory only)

Performance Objectives:

Given a lecture presentation and necessary information, the student will learn the proper procedures and standard requirements for the layout, cutting and installation of cripple jack rafters.

Evaluation Criterion:

The student will demonstrate his understanding of the task by participating in the classroom discussions and question/answer sessions to the satisfaction of the instructor.

Performance Guide:

Know the following steps for the job:

1. Determine the pitch of the roof if not given in the plans (rise per foot run of the common rafter).
2. Determine the run:
   The run can be determined by measuring the length of the plate between the hip and valley rafters.
3. Using the rise and run, calculate the length of the crippled jack in the same manner used for the common rafters.
4. Use the rise per foot run on the tongue and the base figure for the hip, valley and jack rafters on the blade of framing square to mark cuts.
5. Deduct one-half the 45° thickness of the hip and one-half the 45° thickness of the valley from the overall length of jack.
6. Lay out and mark the side cuts following procedures for hip and valley jacks:
   a. The top cheek cut layout is the same as for a hip jack rafter.
   b. The bottom cheek layout is the same as for bottom cut on the valley jack rafter.
7. Lay out the hip and valley rafters to receive the cripple jacks.

DUTY: MAINTENANCE CARPENTRY - ROOFING

TASK: Lay out, cut and install cripple jack rafters for hip and valley installations. (Theory only)

Performance Guide (cont.):

8. Nail the cripple jacks top and bottom being careful not to cause a bow in either the hip or valley.
9. Check the final installation including alignment, spacing and nailing.

DUTY: MAINTENANCE CARPENTRY - ROOFING

TASK: Lay out, cut and install gable studs. (Theory only)

Performance Objectives:

Given a lecture presentation and information necessary, the student will learn proper procedures and standard requirements in the layout, cutting and installation of the gable studs.

Evaluation Criterion:

The student will demonstrate his understanding of the procedures to the satisfaction of the instructor.

Performance Guide:

Know the following procedures:

1. Plumb down from the center of the ridge to establish a center line on the plate for the layout.
2. Measure one-half of the window or lower opening size on each side of the center line and mark for the first full-length stud where openings exist.
3. Start at each of these fixed locations and lay out the shorter stud spacing 16" on-center to the outsides of building.
4. Measure the two full-length studs. Lay out and cut the top cuts first. Then cut them to the required length.
5. Install these two studs plumb using a carpenter's level.
6. The remaining studs can be laid out by locating each stud on its layout position.
   Plumb and mark the top of stud on the underside of the rafter to determine the length.
7. Cut and install these studs flush with the outside of the rafters and plates.
8. Frame-in the window sills and headers based on the height of the window.

DUTY: MAINTENANCE CARPENTRY - ROOFING

TASK: Lay out, cut and install gambrel roof rafters.

Performance Objectives:

Given a gambrel roof plan, a helper, tools and materials necessary, the student will lay out, cut and install the gambrel rafters.

Evaluation Criterion:

The student will lay out, cut and install the gambrel roof rafters to the satisfaction of the instructor.

Performance Guide:

1. Check the detail plans for the type of construction specified and the unit rise for each of the roof's surfaces.
2. Check the plans to determine the height and location where the bottom section intersects the top section.
3. Check the plans to determine if the two sections require a purlin.
4. Where the above critical data are not provided, a layout plan must be made to scale to determine the point of the roof sections intersection. This can be done full scale on the subflooring or a flat surface large enough.
5. Lay out a semicircle using one-half of the major span for the building as a radius.
6. Establish the intersection point by bisecting the 90° angle of the semicircle.
7. Determine the required height of the lower section rafters and position of purlin. This establishes the rafter run and rise units.
8. Calculate the rafter length using these run and rise figures.
9. Lay out lower section rafters using these run and rise figures for top and bottom cuts.
10. Cut the rafter and use as a pattern for cutting the required number of common rafters for the lower section.
11. Determine the rise and run of the upper section rafters.

DUTY: MAINTENANCE CARPENTRY - ROOFING

TASK: Lay out, cut and install gambrel roof rafters.

Performance Guide (cont.):

12. Lay out and cut a pattern rafter to cut the required number of rafters for the upper section.
13. Erect the lower section rafters first if a purlin wall construction method is used.
14. Erect the top section rafters using the purlin as a plate for these rafters.
15. Align and brace all rafters in place.
16. Have the instructor check your work.

DUTY: MAINTENANCE CARPENTRY - ROOFING

TASK: Lay out, cut and install hip rafters for equal-pitch roofs. (Theory only)

Performance Objectives:

Given a lecture presentation, and necessary information, the student will outline in detail the proper procedures for the layout and installation of the hip rafters for equal-pitch roofs.

Evaluation Criterion:

The student will demonstrate his understanding of the task to the satisfaction of the instructor.

Performance Guide:

Know the following procedures for the job:

1. Calculate the rise of the common rafters per foot run.
2. The run for a hip rafter per foot run of the roof span is fixed at 17" for layout. Use this figure for the horizontal base of the triangle for layout of the hip..
3. Determine the length per foot run of the hip by measuring the diagonal distance between rise per foot run setting on the square to the run which is fixed at 17".
4. Multiply this length per foot run by the number in feet of the roof's run (1/2 of the span) to calculate the total length of the hip.
5. Calculate the allowance for the thickness of the ridge and deduct this from the total length of the hip. NOTE: This calculation must be done using the 17" base.
6. Select a straight piece of stock (full length) and lay out the hip rafter for all required cuts. Make sure that the cut is the proper depth so that the top corners of the hip will be in the same plane as the common rafter.
7. Make the required cuts and use this as a pattern.

DUTY: MAINTENANCE CARPENTRY - ROOFING

TASK: Lay out, cut and install hip rafters for equal-pitch roofs. (Theory only)

Performance Guide (cont.):

8. Cut the required hips using the pattern for the layout.
9. Install the hip rafters in pairs nailing the seat to the plate first and then nail to the ridge.
10. Check for the alignment and nailing.

DUTY: MAINTENANCE CARPENTRY - ROOFING

TASK: Lay out, cut and install hip jack rafters. (Theory only)

Performance Objectives:

Given a lecture presentation, and information necessary, the student will outline the proper procedures for installation of the hip jack rafters.

Evaluation Criterion:

The student will demonstrate his understanding of the task to the satisfaction of the instructor.

Performance Guide:

Know the following procedures for the job:

1. Locate the difference in length of jacks on the carpenters square rafter table for the o.c. spacing under the roof rise figure. This length is consistent and is called the common difference.
2. Locate the side cut figure to be used in the appropriate column under the roof rise figure.
3. Lay out the bird's mouth (plate) and overhang from the common rafter pattern.
    a. Hip jacks plate cuts, overhang and cornice will be same as common rafters.
4. Lay out the line length of the longest jack the same as the common rafter after deducting the common difference in length and figuring for the ridge deduction.
    Ridge deduction is figured by one-half the 45° thickness of the hip.
5. Lay out the side (cheek) cut.
    a. Take the unit run of the common rafter on the body of the square and the length per foot run (of the jack) on the tongue.
    b. Mark on the outside edge of the tongue.

DUTY: MAINTENANCE CARPENTRY - ROOFING

TASK: Lay out, cut and install valley rafters for equal-pitch roofs. (Theory only)

Performance Objectives:

Given a lecture presentation and the necessary roof plan, the student will outline the proper procedures for the layout and the installation of the valley rafters for equal-pitch roofs.

Evaluation Criterion:

The student will demonstrate his understanding of the task to the satisfaction of the instructor.

Performance Guide:

Know the following procedures for the job:

1. Calculate the unit rise of roof per foot run (or determine this from the roof plan).
2. Determine the unit run of the valley rafter (fixed at 17").
3. Calculate or determine the unit length of the valley rafter: Diagonal distance from the unit rise to the unit run (17") on the carpenters' square.
4. Multiply the unit length by the total number of units run to determine the total length of the valley.
5. Lay out the plumb cut top of rafter using the unit rise and unit run figures on a carpenters' square.
6. Lay out the cheek cut for the top of rafter.
7. Measure the total length of the rafter and deduct one half the 45° thickness of ridge.
8. Lay out the plumb seat (bird's mouth) cut for the plate.
9. Lay out the tail section of the rafter for the type cornice.
10. Make the required cuts on the rafter.
11. Nail the rafter in place.
12. Check for the alignment and position location.

DUTY: MAINTENANCE CARPENTRY - ROOFING

TASK: Lay out wall plates and ridge board to receive rafters.

Performance Objectives:

Given a detailed plan of a roof layout, a helper, necessary tools and materials, the student will lay out the wall plates and ridge board to receive the rafters.

Evaluation Criterion:

The student will complete the task to the satisfaction of the instructor.

Performance Guide:

1. Check the plan for spacing o.c. rafters.
   NOTE: All framing will be laid out from the same end of the building.
2. Cut the top plate section to the exact length at the same time the bottom outside wall plate is installed.
3. Measure and cut the ridge board to the exact length.
4. After the outside bottom wall plates have been installed and the layout for the studs is made, lay the top plates parallel and check to see if the rafter layout will coincide with the stud layout.
5. When possible, lay out the rafters position to coincide with the wall stud layout. Place the bearing weight of the roof directly over the studs.
6. Lay out one of the outside walls first.
7. Lay out the opposite outside wall starting from the same end of the building.
   When possible, both outside walls should be laid out side by side to avoid crossing the rafters.
8. Lay out the ridge board at the same time as the plates.
9. Place an "X" on the side of layout marking to avoid nailing on the wrong side of the layout markings.
10. Check all the layout markings carefully to avoid errors.
11. Have the instructor check your work.

Introduction and Outline:

English
Spanish
Laotian

CE029 814

INTRODUCTION TO MAINTENANCE MECHANICS

CAREER DEVELOPMENT CENTER
SCHOOL OF TECHNICAL CAREERS
SOUTHERN ILLINOIS UNIVERSITY
CARBONDALE, ILLINOIS

COMPETENCY-BASED VOCATIONAL/TECHNICAL CURRICULUM SERIES

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June 1981

ARDEN L. PRATT, DEAN
E. HOLLIS MERRITT, ASST. DEAN
LARRY HEPBURN, CENTER DIRECTOR

INTRODUCTION

The purpose of the maintenance mechanics program is to provide the student with technical and vocational training integrated with practical experiences in all of the job classifications within the program.

The program runs 40 weeks covering 5 instructional areas: basic electricity (14 weeks); maintenance and repair of heating (4 weeks); maintenance and repair of air conditioning (12 weeks); maintenance plumbing (3 weeks); and maintenance carpentry (7 weeks). The class meets 2 hours each day in related education or G.E.D. classes, and 6 hours each day in occupational education (up to 2 hours of shop-lecture on technical theories and a minimum of 4 hours each day of practical shop experience). The program is a continuous circular instructional system with student input at the beginning of each curriculum.

Even though many industries always advertise for maintenance mechanics, their requirements are rather strict due to the fact that most maintenance departments are understaffed, underbudgeted and consequently overworked. Employers look for the type of individual, who has a high degree of maturity and reliability, who can function without direct supervision, who follows directions explicitly, and who has the motivation and initiative to take care of any given situation.

There is no substitute for experience. A person can find a job in maintenance provided he has a proven work record plus the technical skills and working knowledge of the field.

A maintenance mechanic is always the last to be laid off and the first to be rehired even in an adverse economic climate. If an individual can meet the above requirements, he or she can always find work in maintenance. The institutional, industrial, and housing authority areas are examples of where maintenance jobs can be found.

MAINTENANCE MECHANICS: DUTY-TASK INDEX

I. BASIC AIR-CONDITIONING

1. Use a voltmeter, ammeter and ohmmeter.
2. Trace a 120V electrical circuit. (Theory only)
3. Dismantle and assemble a single-phase motor.
4. Test an open type capacitor-start electric motor.
5. Check and adjust a thermostat. (Theory only)
6. Check a current relay.
7. Check a potential relay.
8. Check a thermal relay.
9. Check a solenoid valve.
10. Make electrical connections.
11. Test a capacitor-start hermetic motor.
12. Test and operate a capacitor-start, capacitor-run (CSR) hermetic motor.
13. Replace a relay and overload protector.
14. Replace a condensor fan motor.
15. Replace an evaporator fan motor.
16. Check all electrical components of a 120V air-conditioning system.
17. Check a 120V system with a 24V control circuit.
18. Trace the circuits and draw the wiring diagram for a commercial refrigerating system.

II. AIR-CONDITIONING

1. Remove, test, install and adjust a thermostatic expansion valve. (Theory only)
2. Remove, clean, install and operate an oil separator. (Theory only)
3. Remove, inspect, install and adjust a commercial type pressure motor control. (Theory only)
4. Install a remote air-cooled condenser. (Theory only)
5. Install and test a rooftop system. (Theory only)
6. Locate trouble in a water-cooled system. (Theory only)

III. RESIDENTIAL AIR-CONDITIONING

1. Add oil to a hermetic system.
2. Add refrigerant to a hermetic system.
3. Install a filter-drier.

IV. AIR-CONDITIONING

1. Measure relative humidity and dew point. (Theory only)

IV. AIR-CONDITIONING (cont.)

2. Measure air velocity in a duct using an anemometer. (Theory only)
3. Install and use a water manometer. (Theory only)
4. Measure air velocity in a duct using a pitot tube. (Theory only)
5. Measure air velocity in a duct using a velocimeter. (Theory only)
6. Measure pressure drop through a filter. (Theory only)
7. Install and operate airflow control. (Theory only)
8. Install a window type comfort cooler.
9. Install a residential central cooling system. (Theory only)
10. Install a rooftop comfort cooling system. (Theory only)
11. Install a heat pump. (Theory only)
12. Locate trouble in a window type comfort cooler.
13. Locate trouble in a heat pump. (Theory only)
14. Locate trouble in a residential central comfort cooling system. (Theory only)
15. Locate trouble in a water chiller. (Theory only)

V. HEATING

1. Install and operate an atmospheric gas burner with pilot light. (Theory only)
2. Install and operate a blower type gas burner with electric ignition. (Theory only)
3. Install and operate a gun type oil burner. (Theory only)
4. Check and connect a heating thermostat.
5. Check and connect a combination thermostat.
6. Remove, clean and replace an oil burner nozzle. (Theory only)
7. Remove, test and replace an oil burner motor. (Theory only)
8. Remove, test and install an oil burner primary control. (Theory only)
9. Remove, test and install an oil burner safety control. (Theory only)
10. Install a power humidifier in a duct system. (Theory only)
11. Balance airflow in forced air system. (Theory only)
12. Replace a pump on hydronic system. (Theory only)
13. Install and operate an electric heating system. (Theory only)
14. Locate trouble in a gas burner system.
15. Make a stack flue gas analysis. (Theory only)
16. Operate and test a baseboard electric resistance heating system.

MAINTENANCE MECHANICS: DUTY-TASK INDEX

VI. PLUMBING - JOINING PIPE

1. Join cast-iron soil pipe, using lead and oakum.
2. Cut steel pipe with one-wheel cutter.
3. Join copper tubing/pipe to plastic pipe.
4. Using sweat method, join copper tubing/pipe to plastic pipe.
5. Join copper tubing to steel pipe.
6. Join plastic pipe, using solvent cement method.
7. Join plastic pipe to steel pipe.
8. Thread steel pipe with nonadjustable die.
9. Replace a section of galvanized water supply line.
10. Repair leaky water faucets or valves.

VII. PLUMBING - DRAINS

1. Install cleanouts on drains. (Theory only)
2. Lay out house drains. (Theory only)
3. Make water tests on building drains. (Theory only)
4. Rough-in waste and vent lines for bathtubs. (Theory only)
5. Rough-in waste and vent lines for built-in lavatories. (Theory only)
6. Rough-in waste and vent lines for floor-mounted water closets. (Theory only)
7. Clear obstructions from lavatory drains.
8. Remove obstructions from main drain lines.
9. Remove obstructions from water closet drains.
10. Replace lavatory trap drains.
11. Repair water flush valves on water closets.

VIII. PLUMBING - VENTS

1. Install soil or waste back vents. (Theory only)
2. Install vent terminals (roof-flashing). (Theory only)

IX. PLUMBING - AIR CONDITIONING AND HEATING

1. Bend copper tubing with spring bender.
2. Braze pipe with gas torch and filler metal.
3. Cut copper tubing with hacksaw.
4. Cut copper tubing with tubing cutter.
5. Join copper tubing/pipe to copper pipe/tubing.
6. Join copper tubing with compressed connectors.
7. Install temperature and pressure relief valves on boilers. (Theory only)
8. Clean deposits from boilers. (Theory only)

IX. PLUMBING - AIR CONDITIONING AND HEATING (cont.)

9. Perform leak tests on gas supply lines. (Theory only)
10. Clean and adjust gas burners. (Theory only)
11. Install check valves on water feed lines. (Theory only)
12. Install strainers in condensate-return lines. (Theory only)

X. CARPENTRY - BUILDING MATERIALS

1. Identify actual sizes of milled lumber in relation to nominal sizes.
2. Identify defects and blemishes that affect durability and strength of lumber.
3. Stack and care for lumber.
4. Identify job safety requirements.

XI. CARPENTRY - HAND AND POWER TOOLS

1. Use personal protective equipment.
2. Bore holes with drill press. (Theory only)
3. Check installation for level and plumb with a carpenter's level.
4. Copy and transfer angles using sliding T-bevel and framing combination squares as layout tools.
5. Read and measure with rules and squares.
6. Cut chamfers with table saw.
7. Cut compound miters with table saw.
8. Cut dado with portable router.
9. Cut irregular shaped patterns with saber and band saws.
10. Cut large sheets of plywood and wallboard with table saw.
11. Drill-bore holes with portable hand drill.
12. Glue wood stock with hand and bar clamps.
13. Joint stock with the jointer.
14. Make butt joints.
15. Make dado joints.
16. Make lap joints.
17. Make miter joints.
18. Make rabbet joints.
19. Plane stock to thickness with single surface planer (surfacer).
20. Rip plywood with portable saw.
21. Sand finish materials by hand.
22. Sand surfaces and edges with belt sander.
23. Select proper hammer and drive various types and sizes of nails.
24. Set nails with nail set and apply wood filler.
25. Service and maintain portable woodworking power tools.

MAINTENANCE MECHANICS: DUTY-TASK INDEX

XII. CARPENTRY - INTERIOR FINISH

1. Apply finishes.
2. Fit and hang interior doors.
3. Install dry-wall boards.
4. Install metal corners for dry wall.
5. Install entrance and interior door lock sets.
6. Trim interior door openings.

XIII. CARPENTRY - ROUGH FRAMING

1. Build saw horses.
2. Align and brace a wall from corner to corner.
3. Apply subbases over subfloors.
4. Build corner posts.
5. Frame exterior wall.
6. Frame and align a partition wall.
7. Frame and install a built-up "T" sill.
8. Frame and install box sills.
9. Frame built-up girders.
10. Frame floor opening. (Theory only)
11. Frame a wall opening.
12. Identify framing members. (Theory only)
13. Cut and install ceiling (frame) joists. (Theory only)
14. Install diagonal bracing.
15. Install firestops. (Theory only)
16. Install floor joists.
17. Install sill plates on foundation wall.
18. Install post and beam framing. (Theory only)
19. Install structural sheathing.
20. Lay subfloors.

XIV. CARPENTRY - ROOFING

1. Apply insulation (underlay) for asphalt shingles.
2. Build roof trusses.
3. Calculate the rise and run of a common roof.
4. Determine length of rafter scale.
5. Flash chimney. (Theory only)
6. Flash valleys for asphalt shingles. (Theory only)
7. Install asphalt composition (strip) shingles.
8. Roof styles. (Theory only)
9. Install and align ridge boards.
10. Install roof sheathing.
11. Lay out, cut and install ceiling joist.
12. Lay out, cut and install common rafters for equal-pitch roofs.
13. Lay out, cut and install common rafters for unequal-pitch roofs. (Theory only)

XIV. CARPENTRY - ROOFING (cont.)

14. Lay out a common roof plan. (Theory only)
15. Lay out, cut and install cripple jack rafters for hip and valley installations. (Theory only)
16. Lay out, cut and install gable studs. (Theory only)
17. Lay out, cut and install gambrel roof rafters.
18. Lay out, cut and install hip rafters for equal-pitch roofs. (Theory only)
19. Lay out, cut and install hip jack rafters. (Theory only)
20. Lay out, cut and install valley rafters for equal-pitch roofs. (Theory only)
21. Lay out wall plates and ridge board to receive rafters.

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TRANSLATED BY

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INTRODUCCIÓN

El propósito del programa para mecánicos del mantenimiento es el de proveer al alumno con el adiestramiento técnico y vocacional junto con la experiencia práctica en una o más de las clasificaciones en él incluidos.

El programa es de 40 semanas que incluyen 5 campos de instrucción: conocimientos básicos de electricista (14 semanas aproximadamente); mantenimiento y reparaciones de aparatos para el aire acondicionado (12 semanas aproximadamente); mantenimiento y reparaciones de equipo para la calefacción (aproximadamente 4 semanas); mantenimiento de la plomería, (3 semanas aproximadamente); y la carpintería para el mantenimiento (7 semanas aproximadamente). La clase se reúne 2 horas al día como parte del programa afín o del programa de Desenvolvimiento Educativo General (GED), y además hay 6 horas al día de adiestramiento en los oficios afines (hasta 2 horas al día de conferencias en el taller sobre las teorías técnicas y un mínimo de 4 horas diariamente de práctica en el taller o en la obra práctica). El programa opera según el plan de instrucción continua con la entrada y salida de alumnos cada siete semanas.

Aunque muchas industrias buscan siempre mediante sus anuncios mecánicos del mantenimiento, sus requisitos son bastante exigentes debido al hecho del presupuesto limitado del los departamentos de mantenimiento, el número restringido de empleos y el consiguiente volumen de trabajo. Los patrones buscan por

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eso el tipo de individuo con madurez y formalidad, que sepa realizar sus trabajos sin la supervisión directa, que siga a la letra las instrucciones, y que tenga la motivación y la iniciativa necesarias para dominar cada problemática.

No hay substituto por la experiencia. Sin embargo, el individuo puede encontrar empleo en el mantenimiento si posee buena fama en el trabajo además de la destreza técnica y los conocimientos derivados del trabajo en un campo de actividad.

El mecánico en el mantenimiento es siempre el último a despedirse y el primero a emplearse de nuevo aún en las circunstancias económicas adversas. Si el individuo llega a tener los requisitos ya indicados, siempre encontrará empleo en el mantenimiento en alguna institución, industria, o administración habitacional, u otro campo de actividad.

MAINTENANCE MECHANICS: DUTY-TASK INDEX

LA MECÁNICA DEL MANTENIMIENTO: RELACIÓN DE DEBERES Y TRABAJOS

I. AIRE ACONDICIONADO BÁSICO

1. Emplear un voltímetro, amperímetro, y ohmiómetro.
2. Trazar un circuito de 120 voltios. (Teoría solamente)
3. Desarmar y armar un motor eléctrico de una fase.
4. Probar un motor eléctrico del tipo con capacitador-arranque.
5. Checar (Revisar) y ajustar un termostato. (Teoría solamente)
6. Checar (Revisar) un relé (o relai) de fuerza eléctrica.
7. Checar (Revisar) un relai de potencial.
8. Checar un relai térmico.
9. Checar una válvula solenoide.
10. Hacer conexiones eléctricas.
11. Probar un motor hermético de arranque capacitador.
12. Probar y operar un motor hermético de arranque capacitador y controlado por capacitador (CSR).
13. Reponer un relai y protector contra sobrecargas.
14. Reponer un motor y ventilador del condensador.
15. Reponer un motor y ventilador del evaporador.
16. Checar todos los elementos de un sistema de aire acondicionado (refrigeración de aire) de 120 voltios.
17. Checar un sistema de 120 voltios con su circuito de control de 24 voltios.
18. Trazar los circuitos y dibujar un plan diagramático del alambrado de un sistema comercial de refrigeración.

II. AIRE ACONDICIONADO

1. Desmontar, probar, instalar y ajustar una válvula termostática de expansión. (Teoría solamente)
2. Desmontar, limpiar, instalar y operar un separador al aceite. (Teoría solamente)
3. Desmontar, revisar, instalar, y ajustar un control comercial a presión para un motor. (Teoría solamente)
4. Instalar un condensador remoto refrigerado al aire. (Teoría solamente)
5. Instalar y probar un sistema de aire acondicionado montado sobre el techo. (Teoría solamente)
6. Hallar problemas en un sistema refrigerado al agua. (Teoría solamente)

III. AIRE ACONDICIONADO RESIDENTIAL

1. Añadir aceite a un sistema hermético.
2. Añadir refrigerante a un sistema hermético.
3. Instalar un secador-filtro.

MAINTENANCE MECHANICS: DUTY-TASK INDEX

LA MECÁNICA DEL MANTENIMIENTO: RELACIÓN DE DEBERES Y TRABAJOS

IV. AIRE ACONDICIONADO

1. Calcular (Medir) la humedad relativa y punto de formación de rocío (condensación). (Teoría solamente)
2. Calcular (Medir) la velocidad del aire en un conducto empleando un anemómetro. (Teoría solamente)
3. Instalar y emplear un monómetro hídrico. (Teoría solamente)
4. Calcular (Medir) la velocidad del aire en un conducto empleando el tubo de Pitot. (Teoría solamente)
5. Calcular (Medir) la velocidad del aire en un conducto empleando un velocímetro. (Teoría solamente)
6. Calcular (Medir) la caída de presión en una corriente de aire al pasar por un filtro. (Teoría solamente)
7. Instalar y operar un control de corriente de aire. (Teoría solamente)
8. Instalar en una ventana un aparato acondionador de aire de tipo comodidad.
9. Instalar un sistema central residencial de aire acondicionado. (Teoría solamente)
10. Instalar un aparato acondicionador de aire tipo comodidad montándolo en el techo. (Teoría solamente)
11. Instalar una bomba calórica. (Teoría solamente)
12. Localizar problemas en un aparato de aire acondicionado de ventana.
13. Localizar problemas en una bomba calórica.
14. Localicar problemas en un sistema de aire acondicionado central tipo residencial de comodidad. (Teoría solamente)
15. Localizar problemas en un enfriador de agua.

V. CALEFACCIÓN

1. Instalar y operar un quemador atmosférico de gas con llama piloto. (Teoría solamente)
2. Instalar y operar un quemador de gas con soplador y encendido eléctrico. (Teoría solamente)
3. Instalar y operar un quemador de aceite tipo.
4. Checar y conectar un termostato.
5. Checar y conectar un termostato combinado.
6. Desmontar, limpiar y reinstalar la boquilla rociadora de un quemador de petróleo. (Teoría solamente)
7. Desmontar, probar y reinstalar el motor de un quemador de petroleo. (Teoría solamente)
8. Desmontar, probar y reinstalar el control primario de un quemador de petróleo. (Teoría solamente)
9. Desmontar, probar, y reinstalar el control de seguridad de un quemador de petróleo. (Teoría solamente)

V. CALEFACCIÓN (continuación)

10. Instalar un humectador en un sistema de conductos. (Teoría solamente)
11. Reponer la bomba de un sistema hidrónico. (Teoría solamente)
12. Poner en equilibrio la corriente de aire en un sistema al aire forzado. (Teoría solamente)
13. Instalar y operar un sistema eléctrico de calefacción. (Teoría solamente)
14. Localizar problemas en un sistema de quemador de gas.
15. Llevar a cabo un análisis del gas en un humero. (Teoría solamente)
16. Operar y probar un sistema eléctrico de calefacción tipo resistencias en el zócalo.

VI. PLOMERÍA - ENSAMBLE DE TUBERÍA

1. Unir o juntar tubería de alcantarilla de hierro colado, empleando estopa alquitranada y plomo.
2. Cortar tubería de acero con el cortatubos de un solo disco.
3. Juntar tubería de cobre a tubería de plástico.
4. Juntar tubería de cobre y de plástico empleando el sistema del enmanguitado en caliente.
5. Juntar tubería de cobre con tubería de acero.
6. Juntar tubería de plástico con el sistema de solvente-cemento.
7. Juntar tubería de plástico con tubería de acero.
8. Enroscar tubería de acero con hembra fija de terraja.
9. Reponer una sección (trozo) de tubería de entrada de agua.
10. Componer grifos o válvulas que tienen fugas.

VII. PLOMERÍA - EL DRENAJE

1. Instalar ramales de purga u otros accesos al desagüe para permitir que se limpie.
2. Proyectar drenaje para un domicilio. (Teoría solamente)
3. Probar con agua el drenaje de un edificio. (Teoría solamente)
4. Desbastar líneas de drenaje (desagüe) y ventilación para tinas. (Teoría solamente)
5. Desbastar líneas integrales de drenaje (desagüe y ventilación para lavabos. (Teoría solamente)
6. Desbastar líneas de drenaje (desagüe) para lavabos montados en el piso. (Teoría solamente)
7. Purgar drenajes de lavabo.

VII. PLOMERÍA - EL DRENAJE (continuación)

8. Desalojar obstrucciones de líneas principales de drenaje (desagüe).
9. Desalojar obstrucciones del desagüe de W.C.
10. Reponer drenaje de lavabo con sifón inodoro.
11. Componer válvula de cierre en W.C.

VIII. PLOMERÍA - VENTILACIÓN DE DRENAJE

1. Instalar tubo de aspiración o ventilación de desagüe. (Teoría solamente)
2. Instalar guardaguas en la tubería de ventilación. (Teoría solamente)

IX. PLOMERÍA - AIRE ACONDICIONADO Y CALEFACCIÓN

1. Acodillar tubería de cobre con una máquina de curvar de resorte.
2. Soldar con soldadura fuerte tubería empleando la lámpara a soldar de gasolina y metal de aportación (latón).
3. Cortar tubería de cobre con la sierra para metales.
4. Cortar tubería de cobre con cortatubos.
5. Juntar tubería (tubo) de cobre con tubería de cobre.
6. Juntar tubería de cobre con conectores a presión.
7. Instalar válvulas de seguridad o desahogo (para controlar exceso de calor o de presión). (Teoría solamente)
8. Limpiar incrustación mineral de las calderas. (Teoría solamente).
9. Probar líneas surtidoras de gas para localizar fugas. (Teoría solamente)
10. Limpiar y ajustar quemadores de gas. (Teoría solamente)
11. Instalar válvulas de retención en líneas surtidoras de agua. (Teoría solamente)
12. Instalar purgador (colador) en líneas de regreso del condensado. (Teoría solamente)

X. CARPINTERÍA - MATERIALES DE CONSTRUCCIÓN

1. Identificar medidas exactas de madera recanteada con relación a las medidas nominales.
2. Identificar defectos e imperfecciones que afectan la solidez y resistencia de la madera.
3. Apilar y cuidar la madera.
4. Identificar elementos y requisitos de seguridad en el trabajo.

MAINTENANCE MECHANIC: DUTY-TASK INDEX

LA MECÁNICA DEL MANTENIMIENTO: RELACIÓN DE DEBERES Y TRABAJOS

XI. CARPINTERÍA - HERRAMIENTA DE MANO Y DE MÁQUINA

1. Emplear equipo personal de seguridad y protección al trabajador-obrero.
2. Taladrar con prensa taladradora.
3. Checar una instalación para su anivelación y plomada con nivel de carpintero (o albañil).
4. Copiar y transferir ángulos empleando la escuadra falsa en T (ajustable) y la escuadra de hierro de carpintero como herramientas de proyección (desbaste) de la obra.
5. Leer y hacer medidas con reglas (metros) y escuadras.
6. Cortar a bisel con sierra circular (de mesa).
7. Cortar ingletes múltiples con sierra circular.
8. Cortar mortajas con contorneador portátil.
9. Cortar patrones irregulares con sierra de cinta o de vaivén.
10. Cortar hojas grandes de triplay y de fibra prensada con sierra circular.
11. Usar el taladrador de mano.
12. Pegar madera con tornillos de presión.
13. Juntar maderas con cepillo de juntas.
14. Hacer juntas en tope.
15. Hacer juntas de mortaja.
16. Hacer juntas en traslapa.
17. Hacer juntas de inglete.
18. Hacer juntas de ranura - (ensamble de media madera).
19. Cepillar madera hasta espesor indicado con cepillo de una superficie.
20. Aserrar triplay en dirección de la fibra con sierra portátil.
21. Alijar materiales a mano.
22. Alijar superficies y bordes con alijador de cinta.
23. Escoger el martillo adecuado y meter clavos de varios tipos y medidas (números).
24. Meter con el punzón cabezas de clavos y rellenar el hueco con pasta de madera.
25. Limpiar y mantener herramienta portátil de carpintería.

XII. CARPINTERÍA - ACABADO DE INTERIORES

1. Aplicar materiales de acabado: pinturas, barnices, tintes, ceras, y similares.
2. Encajar y montar una puerta.
3. Instalar cartón de yeso o madera prensada para pared.
4. Instalar esquinas de metal en combinación con cartón de yeso en las paredes.
5. Instalar cerraduras en puertas interiores y exteriores.
6. Enmarcar puertas.

XIII. CARPINTERÍA - DESBASTE

1. Construir caballetes de soporte (asnillas).
2. Alinear y colocar riostras en una pared de esquina a esquina.
3. Aplicar subbases (aislamiento) sobre subpisos.
4. Construir el pie derecho de una esquina (el cornijal) de una casa.
5. Ensamblar la pared exterior de una casa.
6. Ensamblar una pared interior de separación de habitaciones y alinearla.
7. Ensamblar e instalar un antepecho de remate en "T".
8. Ensamblar e instalar antepechos encajonados.
9. Ensamblar riguetas compuestas.
10. Ensamblar una apertura de piso. (Teoría solamente)
11. Ensamblar una apertura de pared.
12. Identificar elementos de armazón. (Teoría solamente)
13. Cortar e instalar vigas del techo. (Teoría solamente)
14. Instalar riostras.
15. Instalar detenedores de incendio. (Teoría solamente)
16. Instalar viguetas de piso.
17. Instalar largueros al muro de cimiento.
18. Instalar ensamblaje de derechos y viguetas. (Teoría solamente)
19. Instalar entablado (tablazón) estructural.
20. Colocar pisos estructurales.

XIV. CARPINTERÍA - TECHOS

1. Colocar papel (cartón) asfaltado aislante para debajo de las tejas asfálticos.
2. Construir la armadura de un techo.
3. Calcular el pendiente y la mitad de la arcada de un techo común y corriente.
4. Averiguar el largo de la escala de cabrios.
5. Instalar guardaaguas en una chimenea (humero). (Teoría solamente)
6. Instalar guardaaguas en la limahoya de un techado de tejas asfálticas. (Teoría solamente)
7. Instalar tejas asfálticas en tiras.
8. Estilos de tejado y techado. (Teoría solamente)
9. Instalar y alinear limatesas.
10. Colocar entablado (tablazón) del techado.
11. Disponer, cortar, e instalar vigas de la cubierta.
12. Disponer, cortar, e instalar cabrios comunes para techado de dos vertientes iguales (o de caballete).
13. Disponer, cortar, e instalar cabrios comunes para techado de dos vertientes desiguales. (Teoría solamente)

XIV. CARPINTERÍA - TECHOS (continuación)

14. Trazar un plan de techado común. (Teoría solamente)
15. Disponer, cortar, e instalar cabrios de unión para techado de cuatro vertientes (o de copete) y para limahoyas. (Teoría solamente)
16. Disponer, cortar, e instalar montantes para el frontón de techado piñon de dos vertientes. (Teoría solamente)
17. Disponer, cortar, e instalar cabrios para techado (cubierta) quebrantado (de Monsard). (Teoría solamente)
18. Disponer, cortar, e instalar cabrios de limatesa para techado de dos vertientes iguales. (Teoría solamente)
19. Disponer, cortar, e instalar cabrios de unión. (Teoría solamente)
20. Disponer, cortar, e instalar cabrios de limahoya para techado (cubierta) de dos vertientes iguales. (Teoría solamente)
21. Disponer largueros y viga de limatesa para aceptar (recibir) cabrios.

INTRODUCTION TO MAINTENANCE MECHANICS

LAOTIAN VERSION

CAREER DEVELOPMENT CENTER
SCHOOL OF TECHNICAL CAREERS
SOUTHERN ILLINOIS UNIVERSITY
CARBONDALE, ILLINOIS

COMPETENCY-BASED VOCATIONAL/TECHNICAL CURRICULUM SERIES

INTRODUCTION TO MAINTENANCE MECHANICS

LAOTIAN VERSION

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TRANSLATED BY

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ຄຳນຳ.

ຈຸດປະສົງຂອງຫຼັກສູດສາຍຊ່າງສ້ອມແປງເຄື່ອງເຮືອນ ແລະ ເຄື່ອງໃຊ້ ທີ່ເພື່ອຈະເປີດໂອກາດໃຫ້ນັກຮຽນມີຄວາມຮູ້ວິຊາຊ່າງ ແລະ ມີ ອາຊີບຄວບກັບຄວາມຊຳນານທາງນີ້ ເພື່ອຈະຕຽມຄວາມຊຳນານໃຫ້ເຂົ້າກັບຕຳແໜ່ງ ວຽກທີ່ແປ່ງແຍກກໍໄດ້.

ຫຼັກສູດຈະໃຊ້ເວລາ 40 ອາທິດ ຄອບຄຸມການເປີດສອນ 5 ວິຊາ ດັ່ງນີ້: ກະແສໄຟຟ້າຢ່າງງ່າຍໆ (ປະມານ 14 ອາທິດ), ສ້ອມແປງ ແລະ ຮັກສາ ເຄື່ອງເຮັດຄວາມເຢັນ (ປະມານ 12 ອາທິດ), ສ້ອມແປງ ແລະ ຮັກສາທໍ່ນ້ຳ (ປະມານ 3 ອາທິດ), ສ້ອມແປງ ແລະ ຮັກສາເຄື່ອງເຮັດຄວາມຮ້ອນ (ປະມານ 4 ອາທິດ) ແລະ ການສ້ອມແປງທາງດ້ານຊ່າງໄມ້ (ປະມານ 7 ອາທິດ). ນັກຮຽນຈະໃຊ້ເວລາ 2 ຊົ່ວໂມງ ຮຽນວິຊາທີ່ກ່ຽວພັນ ຫຼື ຕຽມຕົວເພື່ອສອບເສັງທຽບເທົ່າມັດທະຍົມຕອນປາຍ ແລະ ໃຊ້ 6 ຊົ່ວໂມງ ທີ່ເຫຼືອແຕ່ລະວັນຮຽນວິຊາຊີບ. ການຮຽນຮູ້ທາງດ້ານທິດສະດີຂອງຊ່າງ ຈາກຄູສອນຈະໃຊ້ເວລາ ໜ້ອຍເຖິງ 2 ຊົ່ວໂມງ ຈາກ 6 ຊົ່ວໂມງຂອງແຕ່ລະວັນຕົມວິຊາຊີບພາກປະຕິບັດ. ສະນັ້ນ ຢ່າງນ້ອຍ 4 ຊົ່ວໂມງ ຈະຕ້ອງໃຊ້ກັບການເປີດສອນໂດຍການໃຊ້ມື. ຫຼັກສູດຈະມີການຮັບນັກຮຽນເຂົ້າ ແລະ ອອກ ທຸກໆ 7 ອາທິດ.

ເຖິງແມ່ນວ່າ ອຸດສາຫະກຳຕ່າງໆ ມັກຈະມີຄະນະນາຍຊ່າງສ້ອມແປງ ເຄື່ອງເຮືອນ ແລະ ເຄື່ອງໃຊ້ ແຕ່ສ່ວນຫຼາຍເຂົາຈະຕ້ອງການຄົນ

ທີ່ມີຄວາມຮູ້ຄວາມສາມາດແທ້ໆ ເນື່ອງຈາກງົບປະມານນ້ອຍ ແລະ ຜູ້ຊ່ວຍບໍ່ພຽງພໍ ລວມທັງບາງຄັ້ງເຮັດວຽກຫຼາຍເກີນຄວນ. ນາຍຈ້າງຈະເບິ່ງຫາຄົນງານທີ່ມີຄວາມເຊື່ອຖືໄດ້ ແລະ ມີຄວາມເປັນຜູ້ໃຫຍ່ ສາມາດທີ່ຈະດໍາເນີນວຽກການໂດຍບໍ່ຕ້ອງມີຜູ້ຄວບຄຸມເບິ່ງນໍາ ແລະ ເຮັດຕາມຄໍາສັ່ງຢ່າງດີ. ນອກຈາກນັ້ນ ຄົນງານຄົນນັ້ນຈະຕ້ອງມີຄວາມຍະທໄດ້ພາກດີ ມີຄວາມຄິດລິເລີ່ມຂອງຕົນເອງ ແລະ ສາມາດແກ້ບັນຫາໄດ້ ບໍ່ວ່າຈະຢູ່ໃນສະຖານະການໃດໆ.

ຄວາມຊ່ຽວຊານເປັນສິ່ງທີ່ສໍາຄັນທີ່ສຸດ. ບາງຄົນທີ່ຈະຫາວຽກໄດ້ໃນທາງຊ່າງສ້ອມແປງຈະຕ້ອງມີສຸດຫຼັກຖານການງານ ລວມກັບຄວາມຊໍານານທາງຊ່າງນັ້ນໆ ແລະ ຄວາມຮູ້ຂອງການເຮັດວຽກໃນດ້ານນີ້.

ນາຍຊ່າງສ້ອມແປງສ່ວນຫຼາຍຈະເປັນຄົນສຸດທ້າຍທີ່ຈະຖືກພັກງານ ແລະ ຈະເປັນຄົນທໍາອິດທີ່ຈະຖືກຮຽກຕົວກັບເຂົ້າເຮັດວຽກ ຖ້າຫາກວ່າເສຖກິດບໍ່ຄ່ອຍຈະດີ. ຖ້າໃຜທໍາງານມີຄວາມສາມາດ ແລະ ຄຸນວຸດທິຕາມຄວາມຕ້ອງການທີ່ເລົ່າມາ ໃຜຄົນນັ້ນມັກຈະຫາວຽກໃນດ້ານສ້ອມແປງໃນສະຖາບັນຕ່າງໆ ທາງໂຮງງານອຸດສາຫະກໍາ ແລະ ຮ້ານພັກທີ່ຢູ່ຕ່າງ ແລະ ອື່ນໆອີກ.

MAINTENANCE MECHANICS: DUTY-TASK INDEX

ສາຂາວິຊາ: ໜ້າທີ່ ແລະ ການງານຂອງຊ່າງສ້ອມແປງ.

I. BASIC AIR-CONDITIONING ເຄື່ອງເຮັດຄວາມເຢັນທົ່ວໄປ.

1. ການໃຊ້ເຄື່ອງວັດກຳລັງໄຟຟ້າ, ກະແສໄຟຟ້າ, ແລະ ຄວາມຕ້ານທານໄຟຟ້າ.
2. ການໃຊ້ວົງຈອນໄຟຟ້າ ລະບົບ 120 volt (ທິດສະດີ)
3. ການຖອດອອກ-ເຂົ້າ ຂອງໝໍ້ປັ່ນທີ່ໃຊ້ໄຟຟ້າ.
4. ຫັດລອງກວດໝໍ້ປັ່ນຊະນິດ Capacitor-start ແບບເປີດ.
5. ກວດກາ ແລະ ຕັ້ງ Thermostat (ທິດສະດີ).
6. ກວດກາກະແສໄຟ Relay (ເຄື່ອງຊ່ວຍຖອດກຳລັງ).
7. ກວດກາກຳລັງໄຟຟ້າ Relay.
8. ກວດກາອຸນຫະພູມ Relay.
9. ກວດກາ Solenoid Valve.
10. ການຕໍ່ສາຍໄຟຟ້າ.
11. ຫັດລອງກວດ Capacitor-Start Hermetic Motor.
12. ຫັດລອງກວດ ແລະ ແລ່ນໝໍ້ປັ່ນຊະນິດ Capacitor-Start, Capaciter-Run (C.S.R.) Harmetic Motor.
13. ປ່ຽນ Relay ແລະ ເຄື່ອງປ້ອງກັນກະແສໄຟ ສູງເກີນໄປ.
14. ປ່ຽນໝໍ້ປັ່ນພັດລົມຂອງ Condenser.
15. ປ່ຽນໝໍ້ປັ່ນພັດລົມຂອງ Evaporator.
16. ກວດເບິ່ງສ່ວນປະກອບທຸກສ່ວນຂອງເຄື່ອງເຮັດຄວາມເຢັນທີ່ໃຊ້ລະບົບໄຟຟ້າ 120 volt.
17. ກວດລະບົບໄຟຟ້າ 120 volt ຕົວວົງຈອນທີ່ຄວບຄຸມທີ່ໃຊ້ 24 volt.
18. ໃສ່ທາງແລ່ນຂອງໄຟຟ້າຕາມວົງຈອນ ແລະ ວາດທາງແລ່ນຂອງ

ປະພັນ ສິ່ງລັບ ລະບົບເຄື່ອງເຮັດຄວາມເຢັນ ຊະນິດໃຊ້ໃນການຄ້າ.

II. AIR-CONDITIONING ການເຮັດຄວາມເຢັນ.

1. ຖອດອອກ, ທົດລອງກວດ, ໃສ່ ແລະ ຕິດຕັ້ງ Thermostatic Expansion Valve (ຫົກຊົ່ວ).
2. ຖອດອອກ, ລ້າງ, ໃສ່ ແລະ ແລ່ນເຄື່ອງ Oil Separator (ຫົກຊົ່ວ).
3. ຖອດອອກ, ກວດກາເບິ່ງ, ໃສ່ ແລະ ຕິດຕັ້ງ Pressure Motor Control ຊະນິດສຳລັບການຄ້າ (ຫົກຊົ່ວ).
4. ໃສ່ Remote Air - Cooled Condenser (ຫົກຊົ່ວ).
5. ໃສ່ ແລະ ທົດລອງກວດ ລະບົບເຄື່ອງເຮັດຄວາມເຢັນ ຊະນິດຕັ້ງຢູ່ເທິງຫຼັງຄາ (ຫົກຊົ່ວ).
6. ເບິ່ງຫາຕົ້ນເຫດທີ່ເຮັດໃຫ້ເຄື່ອງເພຂອງລະບົບເຮັດຄວາມເຢັນໂດຍໃຊ້ນ້ຳ (ຫົກຊົ່ວ).

III. RESIDENTIAL AIR-CONDITIONING ເຄື່ອງເຮັດຄວາມເຢັນຕາມບ້ານ.

1. ເພີ່ມຕື່ມນ້ຳມັນໃນໝໍ້ປັ່ນ Hermetic System.
2. ຕື່ມນ້ຳຢາທີ່ເຮັດໃຫ້ເຢັນໃນລະບົບ Hermetic System.
3. ໃສ່ເຄື່ອງທາງລຸ່ມ.

IV. AIR-CONDITIONING ລະບົບເຮັດຄວາມເຢັນ.

1. ວັດຄວາມຊຸ່ມຊື່ນ ແລະ ຈຸດນ້ຳຄ້າງ (ຫົກຊົ່ວ).
2. ວັດຄວາມໄວຂອງອາກາດໃນທໍ່ລົມ ໂດຍໃຊ້ Anemometer (ຫົກຊົ່ວ).

3. ອ່ານ ແລະ ໃຊ້ Water Manometer (ທັກສະ).
4. ວັດຄວາມໄວຂອງອາກາດໃນທໍ່ລົມໂດຍໃຊ້ Pilot tube. (ທັກສະ).
5. ວັດຄວາມໄວຂອງອາກາດໃນທໍ່ລົມໂດຍໃຊ້ Velocimeter (ທັກສະ).
6. ວັດຄວາມກົດດັນທີ່ຫຼຸດລົງ ຜ່ານຈາກແຜ່ນເຄື່ອງກອງ ທີ່ຕິດຕັ້ງແລ້ວ (ທັກສະ).
7. ໃຊ້ ແລະ ແລ່ນເຄື່ອງຄວາມຊຸ່ມອາກາດທີ່ຜ່ານ (ທັກສະ).
8. ໃຊ້ເຄື່ອງເຮັດຄວາມເຢັນຊະນິດຕັ້ງຢູ່ປ່ອງຢ້ຽມ.
9. ຕິດຕັ້ງເຄື່ອງເຮັດຄວາມເຢັນ ສຳລັບບ້ານຢູ່ ລະບົບສູນລວມ (ທັກສະ).
10. ຕິດຕັ້ງເຄື່ອງເຮັດຄວາມເຢັນຊະນິດຕັ້ງເທິງຫຼັງຄາ (ທັກສະ).
11. ຕິດຕັ້ງ Heat pump (ທັກສະ).
12. ຫາອັນທີ່ເຮັດໃຫ້ເຄື່ອງຕິດຂັດຂອງເຄື່ອງເຮັດຄວາມເຢັນ ຊະນິດຕັ້ງເທິງປ່ອງຢ້ຽມ.
13. ຫາອັນທີ່ເຮັດໃຫ້ເກີດບັນຫາຂອງ Heat pump (ທັກສະ).
14. ຫາອັນທີ່ເຮັດໃຫ້ເກີດບັນຫາຂອງເຄື່ອງເຮັດຄວາມເຢັນ ຊະນິດໃຊ້ກັບບ້ານລະບົບສູນລວມ (ທັກສະ).
15. ຫາບ່ອນທີ່ເຮັດໃຫ້ເກີດບັນຫາທີ່ເຮັດໃຫ້ນ້ຳເຢັນ.

V. HEATING ການເຮັດຄວາມຮ້ອນ.

1. ຕິດຕັ້ງ ແລະ ກວດລອງແລ່ນເຄື່ອງເຮັດຄວາມຮ້ອນຊະນິດໃຊ້ ກາສ ບັນຈຸໃນຂວດເຫຼັກ ແລະ ຈຸດດ້ວຍ Pilot light (ທັກສະ).
2. ຕິດຕັ້ງ ແລະ ແລ່ນເຄື່ອງເຮັດຄວາມຮ້ອນ ແບບເປົ່າທີ່ໃຊ້ ກາສ ບັນຈຸໃນຂວດເຫຼັກ ແລະ ຈຸດດ້ວຍໄຟຟ້າ (Electronic Igniction) (ທັກສະ)

3. ຕິດຕັ້ງ ແລະ ແລ່ນ ເຄື່ອງເຮັດ ຄວາມ ຮ້ອນ ຊະນິດໃຊ້ຫົວເຜົາ ນ້ຳ ມັນ ກ໊າສ (ຫັກໄດ້).
4. ກວດກາເບິ່ງ ແລະ ຕໍ່ Thermostat ສຳລັບເຄື່ອງເຮັດ ຄວາມຮ້ອນ.
5. ກວດກາເບິ່ງ ແລະ ຕໍ່ Thermostat ຊະນິດລວມ.
6. ຖອນອອກ, ລ້າງ ແລະ ປ່ຽນ ຫົວ ສີດ ຂອງ ນ້ຳ ມັນ (ຫັກໄດ້).
7. ຖອນ ອອກ, ກວດ ແລະ ປ່ຽນ ໝໍ້ ປັ່ນ ຂອງ ເຄື່ອງ ເຮັດ ຄວາມ ຮ້ອນ ທີ່ໃຊ້ ນ້ຳ ມັນ (ຫັກໄດ້).
8. ຖອນ ອອກ, ກວດ ແລະ ຕິດຕັ້ງ ອັນ ຕັ້ງ ຄວບ ຄຸມ ອັນໃໝ່ ອີກຂອງ ເຄື່ອງ ເຮັດ ຄວາມ ຮ້ອນ ທີ່ໃຊ້ ນ້ຳ ມັນ (ຫັກໄດ້).
9. ຖອນ ອອກ, ທົດລອງ ເບິ່ງ ແລະ ຕິດຕັ້ງ ເຄື່ອງ ຄວບຄຸມ ຄວາມປອດໄພ ຂອງ ເຄື່ອງເຮັດຄວາມ ຮ້ອນ ທີ່ໃຊ້ ນ້ຳ ມັນ (ຫັກໄດ້).
10. ຕິດຕັ້ງ ເຄື່ອງເຮັດ ຄວາມຊຸ່ມ ຊະນິດໃຊ້ໄຟຟ້າ ໃນທໍ່ ລົມ ຂອງ ລະບົບເຮັດ ຄວາມ ຮ້ອນ (ຫັກໄດ້).
11. ຕັ້ງ ອາກາດ ທີ່ ແລ່ນ ຜ່ານ ຕອບ ໂຕ້ ລົມ ທາງເທົ່າ ອາກາດ ໃນ ເຮືອນ ເທົ່າ ກັນ (ຫັກໄດ້)
12. ປ່ຽນ ປັ້ມ (Pump) ໃນລະບົບ Hydronic (ຫັກໄດ້).
13. ຕິດຕັ້ງ ແລະ ແຄມ ເຄື່ອງໆ ເຮັດຄວາມຮ້ອນ ໂດຍໃຊ້ໄຟຟ້າ (ຫັກໄດ້).
14. ເບິ່ງຫາ ສາເຫດ ທີ່ ເຮັດໃຫ້ ເຄື່ອງ ເຮັດ ຄວາມ ຮ້ອນ ທີ່ ໃຊ້ ກ໊າສ ອັນ ບໍ່ໃຊ້ໄດ້.
15. ເຮັດ ທໍ່ລະ ບາຍ ອາກາດ ບໍ່ດີ ແລະ ວິທີ (ຫັກໄດ້).
16. ແລ່ນເຄື່ອງ ແລະ ທົດລອງ ກວດ ເຄື່ອງ ເຮັດ ຄວາມ ຮ້ອນ ຊະນິດ ອັນທີ່ ຕິດລະ ຫວ່າງ ຝາ ເຮືອນ ແລະ ພື້ນ ໂດຍໃຊ້ໄຟຟ້າ.

VI. PLUMBING - JOINING PIPE ການປະປາ - ການຕໍ່ທໍ່.

1. ການຕໍ່ທໍ່ລະບາຍນ້ຳສົກກະປົກ ໂດຍໃຊ້ກົ່ວ ແລະ ເຊືອກ.
2. ຕັດທໍ່ເຫຼັກ ດ້ວຍເລື່ອຍຕັດກົ່ວ.
3. ການຕໍ່ທໍ່ທອງແດງກັບທໍ່ພລາສຕິກ.
4. ການຕໍ່ທໍ່ທອງແດງກັບທໍ່ພລາສຕິກໂດຍໃຊ້ຣະບບ Sweat method.
5. ການຕໍ່ທໍ່ທອງແດງ ກັບທໍ່ເຫຼັກ.
6. ການຕໍ່ທໍ່ພລາສຕິກ ເຂົ້າຂອງທໍ່ ໂດຍໃຊ້ກາວ.
7. ການຕໍ່ທໍ່ພລາສຕິກ ກັບທໍ່ເຫຼັກ.
8. ຕັດກຽວເທິງທໍ່ເຫຼັກ.
9. ປ່ຽນຫົວນ້ຳທີ່ຮົ່ວ.
10. ແປງບ່ອນປິດເປີດ ບ່ອນນ້ຳຮົ່ວ.

VII. PLUMBING - DRAINS ການປະປາ - ການລະບາຍນ້ຳ.

1. ຕິດຕັ້ງບ່ອນລົງທໍ່ນ້ຳເທິງທໍ່ລະບາຍ (ທິດສະດີ).
2. ການວາງແປລນທໍ່ລະບາຍ (ທິດສະດີ).
3. ເຮັດການທົດສອບນ້ຳຂອງທໍ່ລະບາຍຂອງຕຶກ (ທິດສະດີ).
4. ການຂຽນແປລນແບບປະລະຍຸດຂອງທໍ່ລະບາຍນ້ຳກັບອາກາດ ສຳລັບຫ້ອງນ້ຳ (ທິດສະດີ).
5. ການຂຽນແປລນແບບງ່າຍໆ ສຳລັບທໍ່ລະບາຍອາກາດ ແລະ ນ້ຳ ສຳລັບອ່າງລ້າງໜ້າ (ທິດສະດີ).
6. ການຂຽນແປລນແບບງ່າຍໆ ສຳລັບທໍ່ນ້ຳ ແລະ ທໍ່ລະບາຍອາກາດຂອງຫົວສ້ວມ (ທິດສະດີ).
7. ເຮັດຄວາມສະອາດທໍ່ລະບາຍນ້ຳຂອງອ່າງລ້າງໜ້າທີ່ຕັນ.

8. ເອົາສິ່ງທີ່ເຮັດໃຫ້ທໍ່ລະບາຍນ້ຳຕັນອອກຈາກທໍ່ໃຫ້ໝົດ.
9. ເອົາສິ່ງທີ່ຕິດຄ້າງຢູ່ໃນຫົວສ້ວມອອກ.
10. ປ່ຽນທໍ່ລະບາຍ, P-Trap ຂອງອ່າງລ້າງໜ້າ.
11. ເປ່ຽນອັນປິດເປີດນ້ຳໃຫ້ໄຫລຄືນຫຼັງຂອງຫົວສ້ວມ.

VIII. PLUMBING - VENTS ການປະປາ - ທໍ່ລະບາຍອາກາດ.

1. ຕິດຕັ້ງທໍ່ລະບາຍອາກາດ ຂອງທໍ່ລະບາຍນ້ຳ (ທິສະດີ).
2. ການຕໍ່ທໍ່ໃຫ້ຜ່ານຫຼັງຄາ (ທິດສະດີ).

IX. PLUMBING - AIR CONDITIONING AND HEATING ການຕໍ່ທໍ່ - ສຳລັບເຄື່ອງເຮັດຄວາມຮ້ອນ ແລະ ຄວາມເຢັນ.

1. ການງໍທໍ່ທອງແດງນ້ອຍໆ ດ້ວຍເຄື່ອງມືງໍຊະນິດສປຣິງ.
2. ຈອດທໍ່ດ້ວຍແປວໄຟໃຫ້ໄດ້ທົ່ວ.
3. ຕັດທໍ່ທອງແດງນ້ອຍໆ ດ້ວຍເລື່ອຍມື.
4. ຕັດທໍ່ທອງແດງນ້ອຍໆ ດ້ວຍເຄື່ອງມືຕັດສະເພາະ.
5. ການຕໍ່ທໍ່ທອງແດງຕ່າງໆ.
6 ການຕໍ່ທໍ່ທອງແດງດ້ວຍຂໍ້ຕໍ່ແບບ Compression.
7. ຕິດຕັ້ງບ່ອນບັນເທົາຄວາມກົດດັນ ແລະ ອຸນຫະພູມທີ່ປິດ ແລະ ເປີດໄດ້ຈາກໝໍ້ນ້ຳ (ທິສະດີ).
8. ລ້າງສິ່ງທີ່ຕິດຢູ່ກັບໝໍ້ນ້ຳອອກ. (ທິສະດີ).
9. ເຮັດການທົດລອງເພື່ອກວດສອບການຮົ່ວຂອງທໍ່ກ໊າຊ (ຟຣູນ). (ທິສະດີ).
10. ລ້າງ ແລະ ຕັ້ງບ່ອນເຕົາໄຟຂອງເຄື່ອງເຮັດຄວາມຮ້ອນ (ທິສະດີ).
11. ຕິດຕັ້ງ Check Valves ເພື່ອກັນນ້ຳທີ່ໄຫລກັບຄືນ (ທິສະດີ).
12. ໃຫ້ຮູ້ເຄື່ອງຕ່າງໆໃນ Condensate - return lines (ທິສະດີ).

15. ເຮັດ Dado Joints.
16. ເຮັດ Lap Joints.
17. ເຮັດ Miter Joints.
18. ເຮັດ Rabbet Joints.
19. ເຊາະຕາມຂ້າງຂອງແຜ່ນໄມ້ດ້ວຍກົບ.
20. ຕັດແຜ່ນໄມ້ອັດດ້ວຍເລື່ອຍໄຟຟ້າ ຊະນິດແຜ່ນວົງກົມ.
21. ຂັດຖູໄມ້ດ້ວຍກະດາດຊາຍ ໃຊ້ມື.
22. ຂັດຖູໄມ້ດ້ວຍກະດາດຊາຍ ເປັນແຜ່ນຍາວໆ.
23. ເລືອກໄມ້ຄ້ອນໃຫ້ຖືກຕ້ອງ ແລະ ຕອກຕະປູຫຼາຍຢ່າງແລະຂະໜາດ.
24. ຕອກຕະປູໃຫ້ນິວຫລບ ແລະ ປິດດ້ວຍ wood filler.
25. ແຕ່ງແລະຮັກສາເຄື່ອງມືທີ່ໃຊ້ໄຟຟ້າຕ່າງໆ.

XII. CARPENTRY - INTERIOR FINISH ການຊ່າງໄມ້ - ວຽກລະອຽດຂ້າງໃນ.

1. ການທາສີ.
2. ຕິດຕັ້ງປະຕູຂ້າງໃນ.
3. ການຕີແຜ່ນຝາ Dry-wall boards.
4. ໃສ່ແຜ່ນເຫຼັກບາງໆທີ່ຫົວມຸມສຳລັບ Dry-wall.
5. ຕິດຕັ້ງກະແຈປິດເປີດສຳລັບປະຕູຂາເຂົ້າ ແລະ ປະຕູຂ້າງໃນ.
6. ຕິດ Trim ຮອບໆໃສ່ຂອບປະຕູດ້ານຂ້າງໃນ.

XIII. CARPENTRY - ROUGH FRAMING ການສ້າງໂຄງບ້ານແບບບໍ່ລະອຽດ.

1. ສ້າງບ່ອນວາງໄມ້ສຳລັບເລື່ອຍ.
2. ຕັ້ງເສົາແລະມຸມ ຕັ້ງໝັ້ນໃຫ້ເຂົ້າຮູບ.
3. ຕີແຜ່ນໄມ້ເທິງຄານຮອງຂອງພື້ນບ້ານ.

4. ສ້າງເສົາດ້ານມຸມສ້າງ.
5. ການສ້າງຝາດ້ານນອກ.
6. ການຕິດຕັ້ງຝາກັ້ນໃຫ້ເຂົ້າຫາກັນ.
7. ການສ້າງ ແລະ ຕິດຕັ້ງ "T" Sill.
8. ການສ້າງ ແລະ ຕິດຕັ້ງ Box Sill.
9. ການຕໍ່ໄມ້ໃຫ້ຍາວ.
10. ການເຈາະບ່ອນລີ້ນລົງຂອງພື້ນ (ທີ່ຄອີ້).
11. ການຕໍ່ຊ່ອງວ່າງເຂົ້າຝາ.
12. ການສະແດງໃຫ້ເຫັນວ່າຮູ້ຈັກ ສ່ວນປະກອບຂອງການ
ຕໍ່ສ້າງ.
13. ຕັດ ແລະ ຕິດຕັ້ງຄານຂອງຫຼັງຄາ.
14. ການໃຊ້ໄມ້ເພີ່ມສ້າງທາງຂວາ.
15. ຕິດຕັ້ງບ່ອນກັນໄຟ.
16. ຕິດຕັ້ງຄານຮອງພື້ນ.
17. ໃສ່ Sill plates ເຂົ້າໃນຂອງຝາ.
18. ການສ້າງໂດຍໃຊ້ເຫຼັກ ແລະ ຄານ.
19. ການຕໍ່ແຜ່ນຝາດ້ານຂ້າງ.
20. ການວາງຄານຮອງພື້ນ.

XIV. CARPENTRY-ROOFING ການຊ່າງໄມ້ - ຫຼັງຄາ.

1. ການໃຊ້ແຜ່ນສນວນຮອງພື້ນກ່ອນຈະມຸງຫຼັງຄາ.
2. ສ້າງຄານຮອງຫຼັງຄາ.
3. ຄິດຫາສ່ວນ ແລະ ຄວາມກວ້າງຂອງຫຼັງຄາ.
4. ຫາຄວາມຍາວຂອງ Rafter Scale.
5. ການໃຊ້ແຜ່ນເຫຼັກຮອຍບ່ອງໄຟ (ຂີດຂີ້).

6. ການໃຊ້ແຜ່ນເຫຼັກໃນການເຊື່ອມມຸມຂອງຫຼັງຄາກັນຮົ່ວ.
7. ການມຸງຫຼັງຄາດ້ວຍກະເບື້ອງເຮັດດ້ວຍ Asphalt.
8. ຫຼັງຄາແບບຕ່າງໆ. (ທິສດີ).
9. ຕິດຕັ້ງ ແລະ ຕັ້ງລະດັບແປ້ນເທິງຍອດຂອງຫຼັງຄາ.
10. ໃສ່ແຜ່ນຮອງພື້ນຂອງຫຼັງຄາ.
11. ວັດແທກ, ຕັດ ແລະ ໃສ່ ceiling joist.
12. ວັດແທກ, ຕັດ ແລະ ໃສ່ Common rafters
ສຳລັບຫຼັງຄາທີ່ມີ Pitch ເທົ່ານັ້ນ.
13. ວັດແທກ, ຕັດ ແລະ ໃສ່ Common rafters ສຳລັບຫຼັງຄາ
ທີ່ມີ Pitch ເທົ່ານັ້ນ (ທິສດີ).
14. ວັດແທກ ແລະ ຂຽນແບບລວມຂອງຫຼັງຄາທັງໝົດ (ທິສດີ).
15. ວັດແທກ, ຕັດ ແລະ ໃສ່ Cripple jack rafters
ສຳລັບການໃສ່ hip ແລະ Valley ຂອງຫຼັງຄາ.
16. ວັດແທກ, ຕັດ ແລະ ໃສ່ Gable studs (ທິສດີ).
17. ວັດແທກ, ຕັດ ແລະ ໃສ່ Gambrel roof rafters.
18. ວັດແທກ, ຕັດ ແລະ ໃສ່ Hip rafter ສຳລັບຫຼັງຄາທີ່ມີ
pitch ເທົ່ານັ້ນ (ທິສດີ).
19. ວັດແທກ, ຕັດ ແລະ ໃສ່ Hip jack rafters
(ທິສດີ).
20. ວັດແທກ, ຕັດ ແລະ ໃສ່ Valley rafters ສຳລັບ
ຫຼັງຄາທີ່ມີ pitch ເທົ່ານັ້ນ (ທິສດີ).
21. ວັດແທກເພື່ອການຕິດຕັ້ງ Wall plates ແລະ
Ridgeboard ສຳລັບຮອງຮັບ rafters.

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MAINTENANCE MECHANICS TECHNICAL TERMS

CAREER DEVELOPMENT CENTER
SCHOOL OF TECHNICAL CAREERS
SOUTHERN ILLINOIS UNIVERSITY
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MAINTENANCE MECHANICS TECHNICAL TERMS

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MAINTENANCE MECHANICS: Air Conditioning and Heating Terms

absolute humidity: amount of moisture in the air; indicated in grains per cubic foot.

absolute pressure: gauge pressure plus atmospheric pressure (14.7 lbs. per sq. in.).

absolute temperature: temperature measured from absolute zero.

absolute zero temperature: temperature at which all molecular motion ceases. (-460°F. and -275°C.).

air cleaner: a device used for removal of airborne impurities.

air cooled condenser: heat of compression is transferred from condensing coils to surrounding air; this may be done either by convection or by a fan or blower.

air sensing thermostat: thermostat unit in which sensing element is located in refrigerated space.

ambient temperature: temperature of fluid (usually air) which surrounds objects on all sides.

atmospheric pressure: pressure that gases in air exert upon the earth: measured in pounds per square inch.

atomize: process of changing a liquid to minute particles, or fine spray.

automatic defrost: system of removing ice and frost from evaporators automatically.

automatic expansion valve (AEV): pressure controlled valve which reduces high pressure liquid refrigerant to low pressure liquid refrigerant.

bath: a liquid solution used for cleaning, plating, or maintaining a specified temperature.

bimetal strip: temperature regulating or indicating device which works on the principle that two dissimilar metals with unequal expansion rates, welded together, will blend as temperatures change.

bleed-valve: valve with small opening inside which permits a minimum fluid flow when valve is closed.

MAINTENANCE MECHANICS: Air Conditioning and Heating Terms

boiling temperature: temperature at which a fluid changes from a liquid to a gas.

Boyle's Law: law of physics - Volume of a gas varies as pressure varies, if temperature remains the same. e.g. If pressure is doubled on quantity of gas, volume becomes doubled, gas has its pressure reduced by one half.

calorie: heat required to raise temperature of one gram of water one degree centigrade.

capacitor: type of electrical storage device used in starting and/or running circuits on many electric motors.

capillary tube: a type of refrigerant control: Usually sevral feet of tubing having small inside diameter, A capilary tube refrigerant control allows high side pressures to balance during off cycle. Also; a small diameter tubing used to connect temperature control bulbs to control mechanisms.

celsius: German language word for centigrade; the metric system of temperature scale.

centigrade scale: temperature scale used in metric system. Freezing point of water is 0; boiling point is 100.

centimeter: metric unit of linear measurement which equals .3937 inches or 1 inch = 2.54 cm.

Charles' Law: the volume of a given mass of gas at a constant pressure varies according to its temperature.

check valve: a device which permits fluid flow only in one direction.

compression: term used to denote increase of pressure on a fluid by using mechanical energy.

compressor: the pump of a refrigerating mechanism which draws a vacuum or low pressure on cooling side of refrigerant cycle and squeezes or compresses the gas into the high pressure or condensing side of the cycle.

compressor, hermetic: compressor in which driving motor is sealed in the same dome or housing that contains the compressor.

MAINTENANCE MECHANICS: Air Conditioning and Heating Terms

condensate: fluid which forms on an evaporator.

condensation: liquid or droplets which form when a gas or vapor is cooled below its dew point.

condense: action of changing a gas or vapor to a liquid.

condenser: the part of refrigeration mechanism which receives hot, high pressure refrigerant gas from compressor and cools gaseous refrigerant until it returns to liquid state.

condenser comb: comb-like device, metal or plastic, which is used to straighten the metal fins on condensers or evaporators.

condenser fan: forced air device used to move air through air-cooled condenser.

control temperature: a thermostatic device which automatically stops and starts motor, operation of which is based on temperature changes.

convection: transfer of heat by means of movement or flow of a fluid or gas.

convection, forced: transfer of heat resulting from forced movement of liquid or gas by means of fan or pump.

cooling tower: device which cools water by water evaporation in air: Water is cooled to wet bulb temperature or air.

counterflow: flow in opposite direction.

"cracking" a valve: opening valve a small amount.

cut-in: temperature or pressure valve which closes control circuit.

cut-out: temperature or pressure valve which opens control circuit.

damper: valve for controlling airflow.

dehumidifier: a device used to remove moisture from air in enclosed space.

detector leak: a device used to detect and locate refrigerant leaks.

MAINTENANCE MECHANICS: Air Conditioning and Heating Terms

dew point: temperature at which vapor (at 100 percent humidity) begins to condense and deposit as liquid.

dichlorodifluromethane: refrigerant commonly known as R-12: Chemical formula is CCl_2F_2. Cylinder color code is white. Boiling point at atmospheric pressure is 21.62 F.

drier: a substance or device used to remove moisture from a refrigeration system.

dry bulb: an instrument with sensitive element which measures ambient (moving) air temperature.

dry bulb temperature: air temperature as indicated by ordinary thermometer.

duct: a tube or channel through which air is conveyed or moved for heating and air conditioning.

evaporation: a term applied to the changing of a liquid to a gas. Heat is absorbed in this process.

evaporative condenser: a device which uses open spray or spill water to cool a condenser: Evaporation of some of the water cools the condenser water and reduces water consumption.

evaporator: part of a refrigerating mechanism in which the refrigerant vaporizes and absorbs heat.

evaporator coil: a device made of a coil of tubing which functions as a refrigerant evaporator.

evaporator fan: fan which cools extended heat exchange surface of evaporator.

expansion valve: a device in refrigerating system which maintains a pressure difference between the high side and low side and is operated by pressure.

fahrenheit scale: on a fahrenheit thermometer, under standard atmospheric pressure, boiling point of water is 212° and freezing point is 32° above zero on its scale.

flare: Copper tubing is often connected to parts of refrigerating system by use of flared fittings. These fittings require that the end of tube be expanded at about 45° angle. This flare is firmly gripped by fittings to make a strong leakproof seal.

MAINTENANCE MECHANICS: Air Conditioning and Heating Terms

flue: gas or air passage which usually depends on natural convection to cause the combustion gases to flow through it. Forced convection may sometimes be used.

foam leak detector: a system of soap bubbles or special foaming liquids brushed over joints and connections to locate leaks.

freezing point: the temperature at which a liquid will solidify upon removal of heat. The freezing temperature for water is 32 F. at atmospheric pressure.

freon: trade name for a family of synthetic chemical refrigerants manufactured by DuPont.

gasket: a resilient or flexible material used between mating surfaces of refrigerating unit parts or of refrigerator doors to provide a leakproof seal.

gas - noncondensible: a gas which will not form into a liquid under any pressure-temperature conditions.

gauge, compound: an instrument for measuring pressures both below and above atmospheric pressure.

gauge, high pressure: an instrument for measuring pressures in range of 0 psig to 500 psig.

gauge, low pressure: an instrument for measuring pressures in range of 0 psig to 50 psig.

gauge manifold: a device constructed to hold compound and high pressure gauges and valved to control flow of fluids through it.

gauge, vacuum: an instrument used to measure pressures below atmospheric pressure.

heat of compression: mechanical energy of pressure transformed into energy of heat.

heat of fusion: the heat released in changing a substance from a liquid state to a solid state. The heat of fusion of ice is 144 Btu per pound.

hermetic motor: compressor drive motor sealed within same casing which contains compressor.

MAINTENANCE MECHANICS: Air Conditioning and Heating Terms

hermetic system: refrigeration system which has a compressor driven by a motor contained in compressor dome or housing.

high side: parts of a refrigerating system which are under condensing or high side pressure.

humidity: moisture; dampness: Relative humidity is ratio of quantity of vapor present in air to greatest amount possible at given temperature.

Kelvin Scale (K): thermometer scale on which unit of measurement equals the centigrade degree and according to which absolute zero is 0°, the equivalent of -273.16°C. Water freezes at 273.16° and boils at 373.16°.

latent heat: heat energy absorbed in process of changing form of substance (melting, vaporization, fusion) without change in temperature or pressure.

liquid receiver: cylinder connected to condenser outlet for storage of liquid refrigerant in a system.

low side pressure: pressure in cooling side of refrigerating cycle.

melting point: temperature at atmospheric pressure, at which a substance will melt.

monochlorodifluoromethane: a refrigerant better known as Freon 22 or R-22. Chemical formula is $CHClF_2$. Cylinder color code is green.

noncondensable gas: a gas which does not change into a liquid at operating temperatures and pressures.

pour point: lowest temperature at which oil will pour or flow.

PSI: a symbol or initials used to indicate pressure measured in pounds per square inch.

PSIA: a symbol or initials used to indicate pressure measured in pounds per square inch absolute. Absolute pressure equals gauge pressure plus atmospheric pressure.

PSIG: a symbol or initials used to indicate pressure in pounds per square inch gauge. The "g" indicates that it is gauge pressure and not absolute pressure.

MAINTENANCE MECHANICS: Air Conditioning and Heating Terms

psychrometer or wet bulb hygrometer: an instrument for measuring the relative humidity of atmospheric air.

psychrometric chart: a chart that shows relationship between the temperature, pressure and moisture content of the air.

purging: releasing compressed gas to atmosphere through some part or parts for the purpose of removing contaminants from that part or parts.

Rankin Scale: a name given the absolute (Fahrenheit) scale. Zero on this scale is -460° F.

refrigerant: substance used in refrigerating mechanism to absorb heat in evaporator coil by change of state from a liquid to a gas, and to release its heat in a condenser as the substance returns from the gaseous state back to a liquid state.

relative humidity: ratio of amount of water vapor present in air to greatest amount possible at same temperature.

saturation: condition existing when substance contains maximum of another substance for that temperature and pressure.

sensible heat: heat which causes a change in temperature of a substance.

specific gravity: weight of a liquid compared to water which is assigned value of (1.0).

specific heat: ratio of quantity of heat required to raise temperature of a body one-degree to that required to raise temperature of equal mass of water one degree.

specific volume: volume per unit mass of a substance.

squirrel cage: fan which has blades parallel to fan axis and moves air at right angles or perpendicular to fan axis.

superheat: temperature of vapor above boiling temperature of its liquid at that pressure.

sweating: This term is used in two different ways in refrigeration work: (1) condensation of moisture from air on cold surface; (2) method of soldering in which the parts to be joined are first coated with a thin layer of solder.

MAINTENANCE MECHANICS: Air Conditioning and Heating Terms

thermostatic expansion valve: a control valve operated by temperature and pressure within evaporator coil, which controls flow of refrigerant. Control bulb is attached to outlet of coil.

ton of refrigeration: refrigerating effect equal to the melting of one ton of ice in 24 hours. This may be expressed as follows:

288,000 Btu/24 hours;
12,000 Btu/1 hour;
200 Btu/minute.

vacuum: reduction in pressure below atmospheric pressure.

vapor pressure: pressure impassed by either a vapor or gas.

vapor, saturated: a vapor condition which will result in condensation into droplets of liquid as vapor temperature is reduced.

viscosity: term used to describe resistance of flow of fluids.

wet bulb: device used in measurement of relative humidity. Evaporation of moisture lowers temperature of wet bulb compared to dry bulb temperature in same area.

MAINTENANCE MECHANICS: Carpentry Terms

annual rings: rings formed by a tree's yearly growth.

balloon framing: a system of small house framing consisting of two by fours extending two stories with inch by quarter ledger strips notched into the studs to support the second story floor house.

bearing posts: vertical member of wood or steel set on concrete footings.

bevel square: a tool for drawing angles.

bevel: the angle that a surface or a line makes with another.

blemish: anything that affects the appearance of the wood.

block bridging: solid wood members nailed between joints to stiffen the floor.

brace: an inclined piece of framing lumber applied to wall or floor to stiffen the structure: Often used on walls as temporary bracing until framing has been completed.

braced frame: a system of wood house framing using posts, girts, and braces forming a sturdy enclosure.

bridging: a system of bracing between floor beams to distribute the floor load.

carpenter's rafter and framing square or steel square: used as a measuring tool for spacing studs, joists, rafters, and for general layout work; also-called the carpenter's rapid calculator: many graduations and tables are on its surface.

check: lengthwise separation of the wood along the grain and across the annual rings.

collar beam: a horizontal tie beam (1" or 2" thick) connecting opposite roof rafters. They stiffen the roof.

combination square: a measuring tool with an adjustable head which may be clamped to the blade at any desired distance from the end of the blade: May be used as an inside or outside tri-square, plumb and level, depth gage, or marking gage.

crosscut saw: a saw with teeth specifically constructed for cutting across the grain of lumber.

dado: a rectangular groove across the width of a board or plank.

dimension yard lumber: lumber 2 to 5 inches thick in any width.

dormer: a projection from a roof usually enclosing a window.

eaves: the overhang of a roof projecting over the walls.

fiber saturation: the point when all the "free water" has left the wood.

flashing: sheet metal or other materials used in roof construction to insure water-tight joints and intersections.

furring: strips of wood or metal applied to a wall or other surface to even it and usually to serve as a fastening base for finish material.

gable: the triangular vertical end of a building formed by the eaves and ridge of a sloped roof: A roof with two sloping surfaces.

gambrel roof: a roof with two pitches; a roof having its slope broken by an obtuse angle (an angle greater than 90° but less than 180°).

girder: a large horizontal beam (of steel or timber): used to support the joists of a floor, the framework of a building, etc.

grain: the width of the annual rings; mark.

gusset: a triangular wooden or metal piece for reinforcing a corner or angle in a joint.

header: (1) a beam placed perpendicular to joists and to which joists are nailed in framing for chimney, stairway, or other openings. (2) a wood lintel.

hip: the external angle formed by the meeting of two sloping sides of a roof.

hip jack rafter: a short rafter extending from the plate to the hip ridge.

MAINTENANCE MECHANICS: Carpentry Terms (cont.)

hip rafter: a rafter extending from the plate to the hip ridge: extends diagonally from an exterior corner of the plate to the ridge.

hip roof: a roof with sloping sides and sloping ends; a roof that rises by inclined planes from all four sides of a building.

jack rafter: a rafter that spans the distance from the wall plate to a hip, or from a valley to a ridge.

jamb: the side and head lining of a doorway, window, or other openings.

joist: one of a series of parallel beams (usually 2 inches thick): used to support floor and ceiling weights, and supported, in turn, by larger beams, girders, or bearing walls.

kerf: a shallow notch in wood cut with a saw.

knots: a defect or blemish in lumber caused by the growth of a branch.

ledger: in balloon framing the board notched into the exterior studs supporting the second story floor beams.

ledger strip: a strip of lumber nailed along the bottom of the side of a girder on which joists rest.

level: perfectly horizontal.

lintel: a horizontal crosspiece over a door, a window, etc. that supports the load (weight) of the structure above it.

medullary rays: fibers or cells that run from the bark of the tree to its center (pith).

miter joint: a joint consisting of two pieces matched and joined at an angle.

mortise: a slot cut into a board, plank, or timber, usually edgewise, to receive tendon of another board, plank, or timber to form a joint.

mullion: the vertical member separating two windows.

nail-set: tool used to set nails in finished surfaces: to set the nailhead below the surface of the lumber and cover with putty, etc.

o.c.: on center: the measurement of spacing for studs, rafters, joists, etc. in a building from center of one member to the center of the next.

pitch: the incline slope of a roof: the ratio of the total rise to the total width of a house, i.e. 8-foot rise and a 24-foot width is a 1/3 pitch.

pith: a center core of a tree; the first year's growth of a tree.

plate: see "sill plate"; "sole plate"; and "top plate".

plumb: perfectly vertical.

plumb bob: tool used to test or establish vertical lines.

plywood: a building material made of layers of wood glued tightly together.

rabbet: a channel cut out of the edge of a board as in ship lap.

radial: a method of sawing lumber so that the annual rings are perpendicular to the surface of the piece.

rafter: one of a series of structural members of a roof designed to support roof loads: The rafters of a flat roof are sometimes called roof joists.

ribbon: in balloon framing, the board notched into the exterior studs supporting the second floor beams.

ridge: the horizontal line at the junction of the top edges of two sloping roof surfaces.

ridge board: the board placed on edge at the ridge of the roof into which the upper ends of the rafters are fastened.

rise: (1) in stairs, the vertical height of a step or flight of stairs; (2) in roof, the vertical height from the plate to the ridge.

run: (1) in roofing, half a span; (2) in stairs, the net width of a step or the horizontal distance covered by a flight of stairs.

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MAINTENANCE MECHANICS: Carpentry Terms (cont.)

shake: a separation of the wood between the annual rings; lengthwise of a board.

sill: (1) the lowest member of the frame of a structure, resting on the foundation and supporting the floor joists or the uprights of the wall; (2) the lowest member of a window frame.

sill plate: a horizontal member anchored to a masonry wall.

sliding T bevel: used in the same way as a try square; its blade is adjustable and may be set at any desired angle.

soffit: the underside covering of an overhang.

sole plate: the horizontal bottom member of a wood stud partition.

solid bridging: braces between floor joists consisting of short pieces with the same cross section as the joists.

span: in roofs, the width at the plate at the gable end of the roof.

steel square or try square: tool commonly used for laying out right angles (90°), and checking the squareness of boards and the straightness of a surface.

stud: one of a series of wood or metal structural members placed as a support in walls and partitions: also called studding or studs.

tail joist: a joist supported at one end by a girder and at the other by a header.

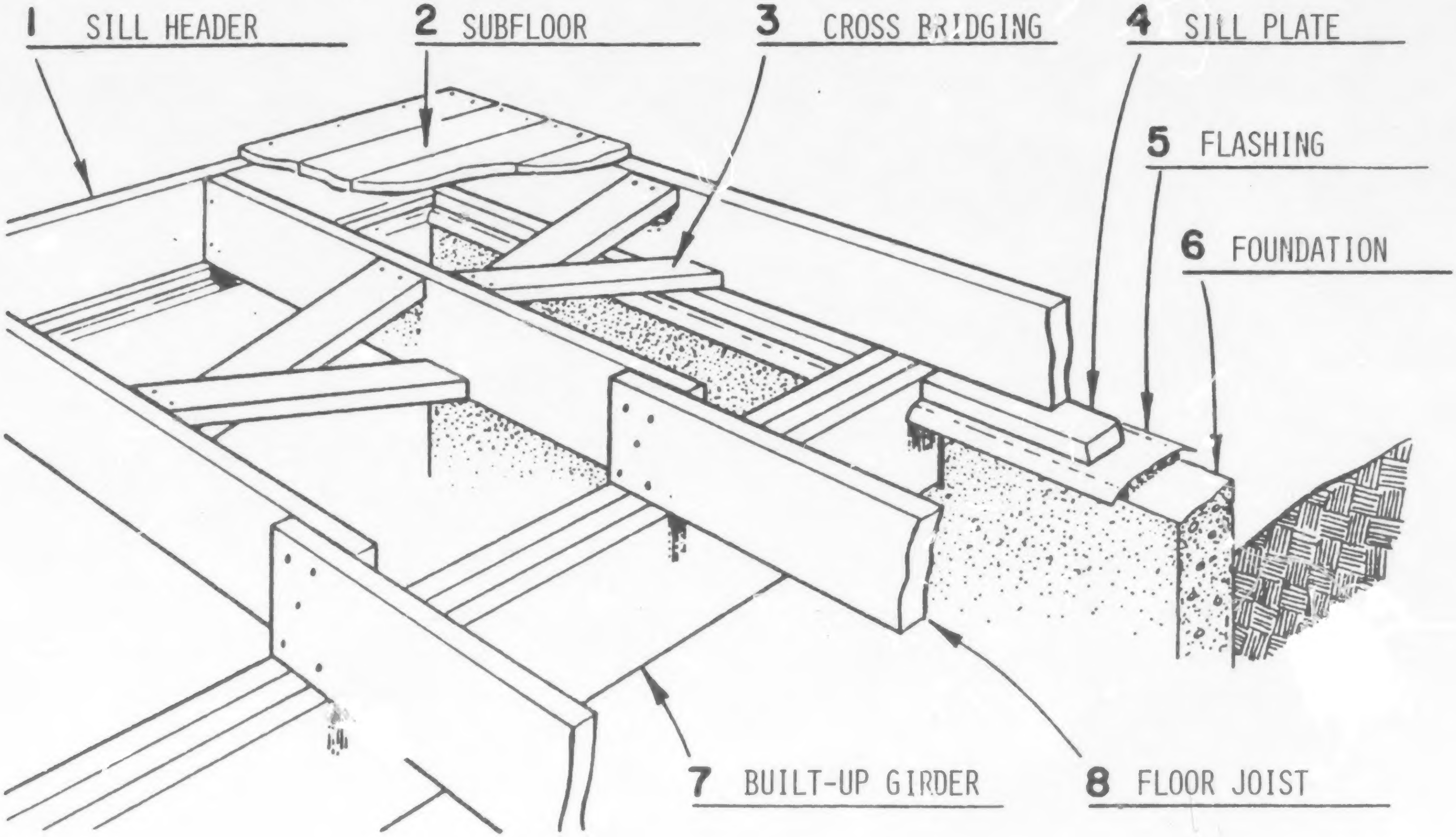
trimmer: a beam or joist to which a header is nailed in framing for a chimney, stairway, or other opening.

truss: a frame or jointed structure designed to act as a beam of long span, while each member is usually subjected to longitudinal stress only (either tension or compression).

valley: the angle formed by the meeting of two slopes of a pitched roof forming a drainage line.

warp: a twist or bend in a wood.

FLOOR AND SILL MEMBERS


1 SILL HEADER
2 SUBFLOOR
3 CROSS BRIDGING
4 SILL PLATE
5 FLASHING
6 FOUNDATION
7 BUILT-UP GIRDER
8 FLOOR JOIST

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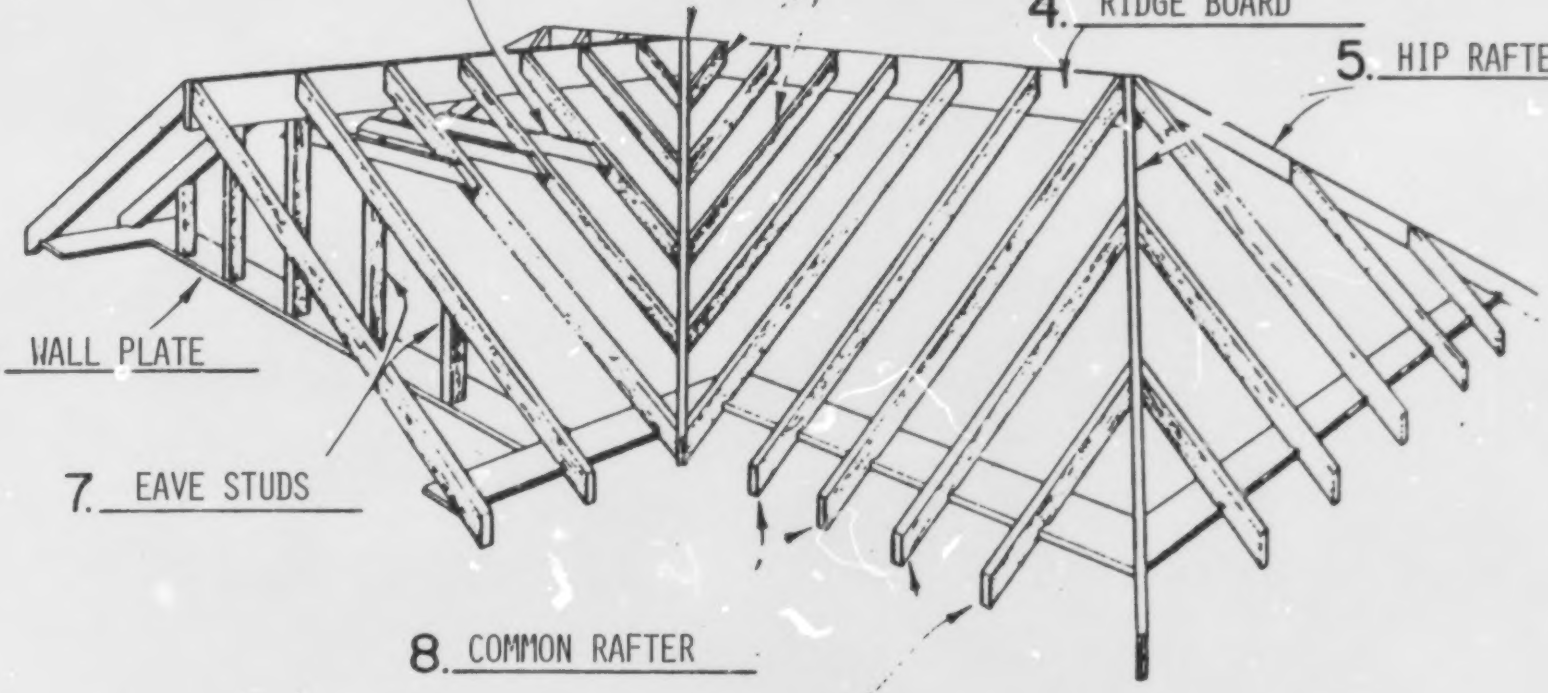
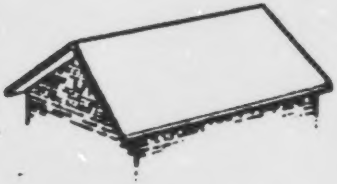
ROOFING MEMBERS

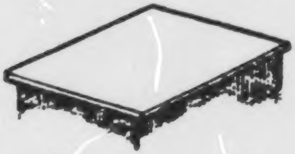


1. VALLEY RAFTER
2. COLLAR BRACE
3. VALLEY JACKS
4. RIDGE BOARD
5. HIP RAFTER
6. WALL PLATE
7. EAVE STUDS
8. COMMON RAFTER
9. HIP JACK

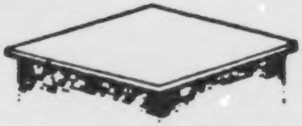
ROOF STYLES



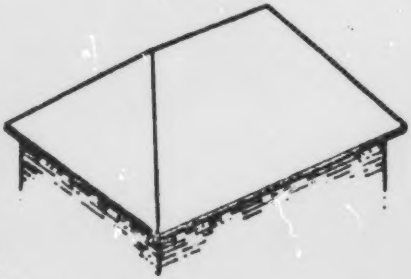
1. GABLE



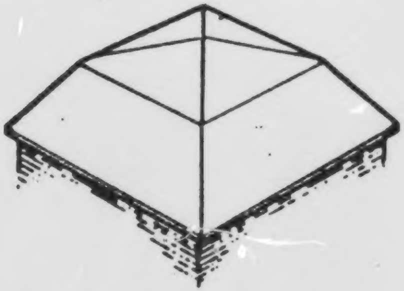
2. SHED



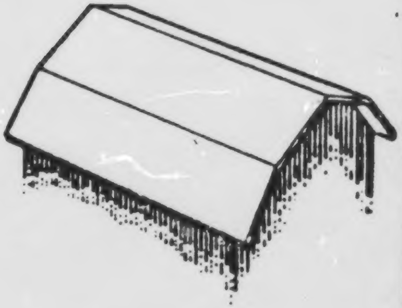
3. FLAT



4. HIP

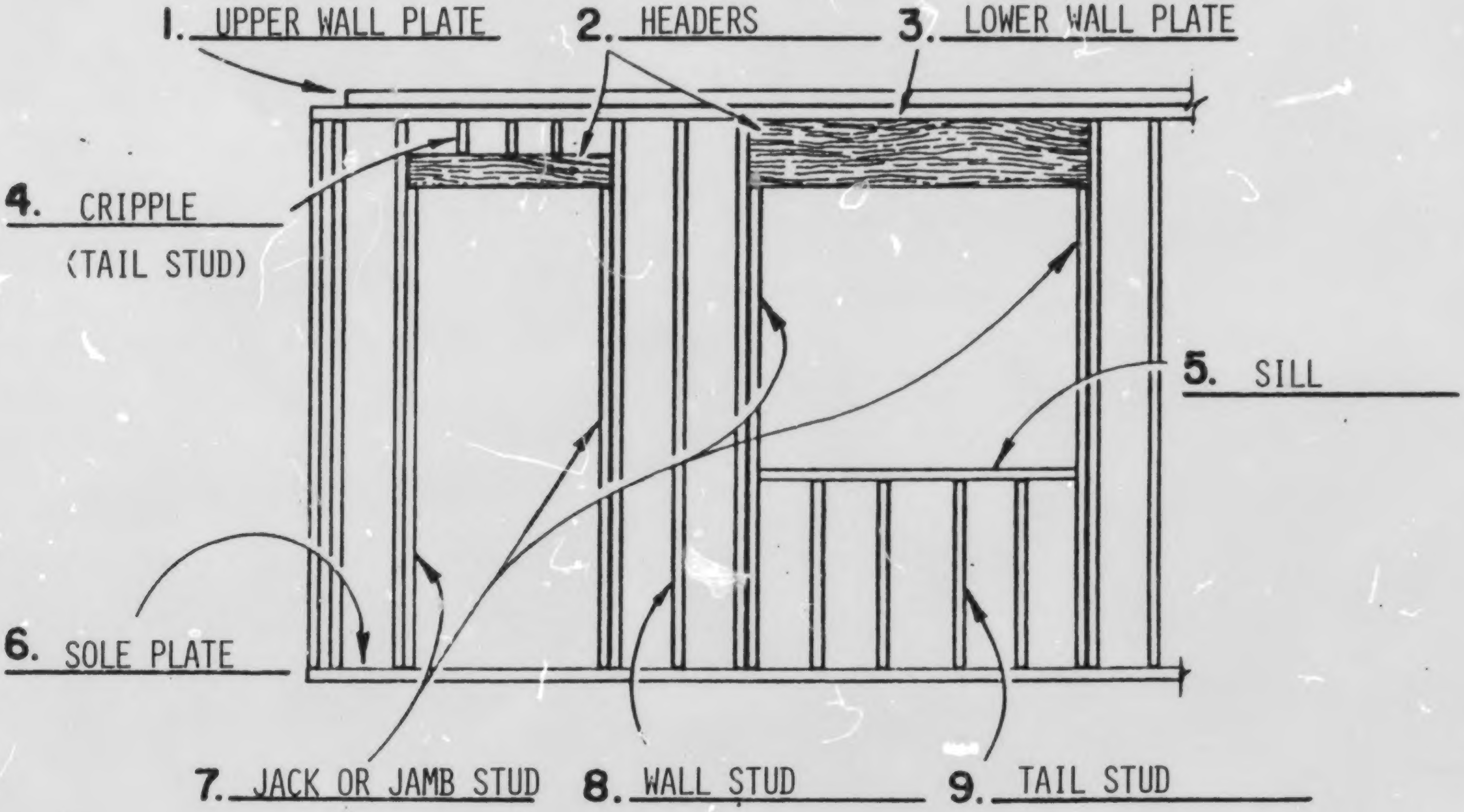


5. MANSARD



6. GAMBREL

WALL FRAMING MEMBERS


1. UPPER WALL PLATE
2. HEADERS
3. LOWER WALL PLATE
4. CRIPPLE
(TAIL STUD)
5. SILL
6. SOLE PLATE
7. JACK OR JAMB STUD
8. WALL STUD
9. TAIL STUD

MAINTENANCE MECHANICS: Carpentry Equipment and Tools

1. bit, auger
2. bit, expansion
3. bolt, toggle
4. brace bit
5. carpenter's measuring stick
6. carpenter's pencil
7. clamps, wood
8. cold chisel
9. drawknife:
10. drill, twist
11. hammers, claw
12. hatchet, claw
13. jigsaw
14. jointer
15. ladder
16. level, builder's
17. mallets
18. mitre boxes
19. nail set
20. pinch bar or crowbar
21. plane, power/hand
22. planer, thickness or surfacer
23. plumb bob
24. pounding tools hammers, mallets, etc.
25. press, drill

MAINTENANCE MECHANICS: Carpentry Equipment and Tools (cont'd)

26. press, power
27. router, portable
28. sander, belt/stroke
29. saw, backsaw
30. saw, band
31. saw, circular
32. saw, compass
33. saw, coping
34. saw, portable/power
35. saw, radial arm
36. saw, saber
37. saw, scroll/stroke
38. saw, straight-back
39. screw, flat-head; slotted
40. screw, lag
41. screw, phillip-head
42. screw, round-head
43. scriber/divider
44. sliding "T" bevel
45. square, combination
46. square, framing or steel
47. square, try and miter
48. stapler or tacker
49. trammel points
50. trowels

MAINTENANCE MECHANICS; Carpentry Equipment and Tools (cont'd)

51. vises
52. wood chisel
53. wood gouge
54. woodmarking gage
55. wrenches

MAINTENANCE MECHANICS: Plumbing Terms

anti-siphon trap: a trap in a drainage system designed to preserve a water seal by preventing siphonage.

basement water main: that part of the water supply system which extends through the basement of a building. All the branches to the fixtures are connected to the basement main.

black pipe: wrought iron or steel pipe painted black; used for air, oil, or railings.

bull head tee: a tee having a branch larger than the run.

bushing: a coupling, having both inside and outside threads, for connecting two pipes of different sizes in the same line; used to reduce the outlets of boiler tanks, etc.

cap: a pipe fitting having only one female thread and a solid end; used for closing off pipe ends.

cast iron pipe: any pipe made of cast iron; used as soil stack, sewer pipe, etc.

check valve: installed in pipe lines to prevent fluids from flowing in the wrong direction.

cleanouts: a fitting in a drainage system made for access to the pipe to clean out obstructions that cause stoppage; usually placed where the pipe changes direction because pipes are more likely to clog at these locations.

close nipple: a nipple completely threaded; all thread nipple.

commode: a personal waste recepticle; toilet.

copper tubing: a copper used for piping.

Advantage:
1. Impervious to rust.
2. Easy to handle in its soft form, and can be bent around obstructions.
3. Can withstand a severe crushing load.
4. Can take freezing temperature six times better than other metals before breaking.

Disadvantage:
1. High cost of initial installation.
2. It expands almost twice as much as iron or steel.

MAINTENANCE MECHANICS: Plumbing Terms - (cont.)

coupling: a pipe fitting used for joining two lengths of pipe together.

crosses: plumbing fittings which have four outlets.

die: a tool used for cutting threads on round stock.

DWU: an abbreviation for drain-waste-unit systems.

elbow: a short threaded fitting connecting two pipes at an angle to each other; used to change the direction of the pipe line.

fitting: a part used to join and/or change size and/or direction of the pipe.
Kinds of fittings: clamp; flare; solder; thread (screw thread).
Functions of the fittings; adapters; bushings; caps; couplings; crosses; flanges; nipples; offsets; plugs; reducers; return bends; tees; unions; wyes.

galvanized pipe: piping coated with zinc to resist rusting; used for water and drainage system as well as for railings and applications above ground where the pipe is exposed to weather.

gate valve: a valve in which a wedge-shaped gate moves up and down at right angles to the path of flow and between two perpendicular seat rings against which it is seated to shut off the flow; operated on the screw principle; used for liquid, pump and main lines where maximum flow is required; known as a stop valve; not to be used for throttling (partly closed): either all the way opened or closed.

globe valve: essentially a control valve; used on water, air, gas, oil, or steam: It may be fully open or partially closed to regulate the flow.

I.D.: inside diameter.

"long pipe": pipe made of wrought iron and steel.

"loop vent": a system where the soil and vent stacks are both located at the same end of a group of fixtures.

main: a part of piping system to which all the fixtures are connected directly or through branch pipes.

nipple: a short length of pipe threaded at both ends; made from black or galvanized steel or wrought iron, and brass pipe.

oakum: a packing material used by plumbers consisting of jute yarn serving to fill joints in bell and spigot pipe.

O.D.: outside diameter.

pipe dope: any of several compounds used for sealing pipes.

P-trap: a trap with a vertical inlet and a horizontal outlet.

return elbow: an elbow with a 180 degree bend; used on pipe coils.

riser: a vertical supply or return pipe for steam, water, or gas.

scale: a build-up of foreign materials inside the pipe.

shoulder nipple: a nipple with a short space between the threads.

siphon: a tube used for taking water out over the top edge of the container through the force of air pressure upon the surface of the water/liquid; one end of the tube is placed in the liquid, the other outside the container below the surface level of the liquid; the tube must be filled as by suction before the flow will start.

siphonage: (1) emptying of the water seal in the traps by air pressure; (2) the backflow of waste water into the drinking water supply due to changes in water pressures and inverted water flow connections.

snake: a tool used to clean out a sewage/drain pipe.

soil stack: the vertical cast iron pipe carrying sewage from the branch waste pipes to the house sewer; the vertical drain pipe which receives the discharge from toilets.

sweating: (1) the soldering, welding or brazing of metals; (2) condensation of water from moist air in contact with a cool pipe.

tank nipple: a nipple made to pass through wooden tanks; the thread being long enough to place washers and locknut on the inside and outside of tanks.

MAINTENANCE MECHANICS: Plumbing Terms - (cont.)

tap: (1) a faucet, spigot, or cock for drawing water from a supply line; (2) a metal tool for cutting internal threads.

tee: a fitting which has three outlets: It is read by giving the large size of the run first, the opposite end next, and the branch last.

threads: a helical or spiral ridge cut on pipe for purpose of joining a pipe to a fitting.

union: a fitting consisting of three parts; two parts are screwed on to the piece of pipe, and a nut or collar is used to draw the two pieces together: Makes it possible to join a pipe to a stationery fixture or boiler and to disconnect them without cutting the pipe.

waste stacks: a vertical drain pipe which receives the discharge of small fixtures (any plumbing fixtures except toilets.)

water hammer: the knocking sound in pipes caused by the concussion of water in enclosed pipes caused by a sudden stoppage of flow.

wet vent: a vent pipe used as a waste pipe below a fixture and as a vent above that point.

wye (Y). a tee with one branch or opening on a 45 degree angle to the other openings; drainage "Y"s are made in single and double patterns and in straight and reducing sizes. "Y"s are used as branches entering drains because all branches must enter at a 45 degree angle to avoid obstruction to the flow of sewage.

yoke vents: vents or bypasses in large buildings installed at intervals of several floors to relieve air pressure.

MAINTENANCE MECHANICS: Plumbing Equipment and Tools

1. air compressor and attachments
2. augers, hand
3. caulking and packing irons
4. chalk line
5. chisels, assorted
6. combination square
7. dividers or trammels
8. electric arc welder
9. files, assorted
10. flaring tool and block
11. folding rule
12. hammers, assorted
13. hand drills and bits
14. hand hacksaw
15. hand pipe threaders
16. hand pipecutters and reaming tools
17. hand saws
18. ladders
19. oxyacetylene torch
20. pedestal and bench grinders
21. pipe taps
22. pipe-threading dies
23. pipe vise
24. pliers, assorted

MAINTENANCE MECHANICS: Plumbing Equipment and Tools (cont.)

25. plumb bob
26. portable air or electric drills
27. portable power saws
28. power rodding equipment
29. powered pipe-cutters, threaders and reamers
30. propane torch
31. punches, assorted
32. retractable steel measuring tapes
33. screwdrivers, assorted
34. soldering irons
35. spirit level
36. spring-type tubing bender
37. strap wrench
38. swaging tools
39. tube cutter or reamer
40. wrenches, assorted

MAINTENANCE MECHANICS TECHNICAL TERMS

ENGLISH-SPANISH LEXICON

CAREER DEVELOPMENT CENTER
SCHOOL OF TECHNICAL CAREERS
SOUTHERN ILLINOIS UNIVERSITY
CARBONDALE, ILLINOIS

MAINTENANCE MECHANICS TECHNICAL TERMS

ENGLISH-SPANISH LEXICON

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MAINTENANCE MECHANICS: Air Conditioning and Heating Terms

MECÁNICA DE MANTENIMIENTO: Terminología de Climatización y Calefacción

absolute humidity: humedad absoluta

absolute pressure: presión absoluta

absolute temperature: temperatura absoluta

absolute zero temperature: temperatura cero absoluta

air cleaner: filtro de aire

air cooled condenser: condensador enfriado por aire

air sensing thermostat: termostato con el elemento sensible situado en espacio refrigerado

ambient temperature: temperatura ambiental

atmospheric pressure: presión atmosférica

atomize: atomizar

automatic defrost: desheladora automática

automatic expansion valve (AEV): válvula automática de expansión

bath: baño, solución para limpiar, enchapar, o mantener una temperatura especificada

bimetal strip: tira bimetálica

bleed valve: válvula de escape

boiling temperature: temperatura de ebullición

Boyle's Law: Ley de Boyle

calorie: caloría

capacitor: capacitador

capillary tube: tubo capilar

celsius: centígrado o celsius

MAINTENANCE MECHANICS: Air Conditioning and Heating Terms

MECÁNICA DE MANTENIMIENTO: Terminología de Climatización y Calefacción

centigrade scale: escala de cien grados

centimeter: centímetro

Charles' Law: Leyde Charles

check valve: válvula de retención

compression: compresión

compressor: compresor

compressor, hermetic: compresor hermético (impenetrable)

condensate: condensado

condensation: condensación

condense: condensar

condenser: condensador

condenser comb: aparato que se asemeja peine, de metal o plastica, usado para fortalecer las rebabas de metal en condensadores o evaporadores

condenser fan: ventilador usado para mover el aire por el condensador enfriado por aire

control temperature: temperatura de control

convection: convección

convection, forced: convección forzada (a presión)

cooling tower: torre de enfriamiento

counterflow: contraflujo

"cracking" a valve: abrir y cerrar rapidamente una valvula para probarla y asegurarse que funciona en forma debida

cut-in: puesto en circuito

cut-out: cortacircuito

MAINTENANCE MECHANICS: Air Conditioning and Heating Terms

MECÁNICA DE MANTENIMIENTO: Terminología de Climatización y Calefacción

damper: regulador de tiro

dehumidifier: deshumedecedor

detector, leak: instrumento que detecta y halla las fugas de mezcla refrigerante

dew point: punto de rocío (temperatura de condensación)

dichlorodifluromethane: diclorodifluorometano

drier: secador

dry bulb: bola seca (se refiere a un termómetro común que registra la temperatura atmosférica).

dry bulb temperature: temperatura común y corriente

duct: conducto

evaporation: evaporación

evaporative condenser: condensador de evaporación

evaporator: evaporador

evaporator coil: serpentín evaporador

evaporator fan: ventilador de evaporador

expansion valve: válvula de expansión

fahrenheit scale: escala de Fahrenheit

flare: abocinar

flue: humero

foam leak detector: método de hallar fugas en juntas y tubería aplicando agua y jabón o líquidos espumosos

freezing point: punto de congelacíon

freon: freón

gasket: empaquetadura, junta

MAINTENANCE MECHANICS: Air Conditioning and Heating Terms

MECÁNICA DE MANTENIMIENTO: Terminología de Climatización y Calefaccion

gas - noncondensible: gas - no condensable

gauge, compound: instrumento para medir presiones tanto las inferiores como las superiores a la presión atmosférica

gauge, high pressure: instrumento para medir presiones de 0 psig a 500 psig

gauge, low pressure: instrumento para medir presiones de 0 psig a 50 psig

gauge manifold: colector manómetro

gauge, vacuum: vacuómetro

heat of compression: calor de compresión

heat of fusion: calor de fusión

hermetic motor: motor hermético

hermetic system: sistema hermético

high side: lado alto

humidity: humedad

Kelvin Scale (K): Escala de Kelvin

latent heat: calor latente

liquid receiver: receptor de líquidos

low side pressure: presión de lado inferior

melting point: punto de fusión

monochlorodifluoromethane: monoclorodifluorometano

noncondensable gas: gas no condensable

pour point: temperatura de fluidez crítica (de petroleos)

PSI: símbola que indica libras por pulgada cuadrada

PSIA: símbola que indica libras por pulgada cuadrada absoluta

MAINTENANCE MECHANICS: Air Conditioning and Heating Terms

MECÁNICA DE MANTENIMIENTO: Terminología de Climatización y Calefacción

PSIG: símbola que indica libras por pulgada cuadrada manómetra

psychrometer or wet bulb hygrometer: psicrómetro o higrómetro de bola mojada

psychrometric chart: diagrama psicrométrica

purging: deshacer de elementos indeseables

Rankin Scale: Escala de Rankin

refrigerant: mezcla refrigerante

relative humidity: humedad relativa

saturation: saturación

sensible heat: calor sensible

specific gravity: gravedad específica

specific heat: calor específico

specific volume: volumen específico

squirrel cage: jaula de ardilla

superheat: supercalor (excesivo)

sweating: 1) condensación resultando de aire húmedo en contacto con superficie fría
2) método de soldadura

thermostatic expansion valve: válvula termostática de expansión

ton of refrigeration: Ciclo de Refrigeración: cada 24 horas = 1 tonelada de hielo

vacuum: vacío; En combinación con otra parabra: vacuum control; vacuo-regulación

vapor pressure: tensión del vapor

vapor, saturated: vapor saturado

viscosity: viscosidad

wet bulb: termómetro medidor de la humedad

MAINTENANCE MECHANICS: Carpentry Terms

MECÁNICA DE MANTENIMIENTO: Terminología de Carpintería

annual rings: anillos anuales

balloon framing: armazón provisional

bearing posts: postes de soporte

bevel square: falsa escuadra

bevel: bisel

blemish: imperfeccion

block bridging: entrelace con puntales de refuerzo

brace: tornapunta

braced frame: armazón arriostrado

bridging: entrelace

carpenter's rafter and framing square or steel square: escuadra de hierro

check: grieta paralela a la fibra

collar beam: viga central

combination square: escuadra combinada

crosscut saw: sierra tronzadera

dado: dado

dimension yard lumber: madera aserrada 2-5 pulgadas de grueso, de cualquier ancho

dormer: buhardilla

eaves: aleros

fiber saturation: el punto cuando todo el "agua libre" se ha salido de la madera

flashing: vierteaguas

MAINTENANCE MECHANICS: Carpentry Terms

MECÁNICA DE MANTENIMIENTO: Terminología de Carpintería

furring: listones de enrasar

gable: gablete (techo de dos aguas)

gambrel roof: techo a la holandesa

girder: viga maestra

grain: fibra

gusset: triángulo de refuerzo

header:
1) brochal
2) lintel de madera

hip: caballete

hip jack rafter: cabrio que se extiende desde el miembro la viga horizontal hasta la limatesa

hip rafter: cabio de limatesa, cabrio de la cresta

hip roof: techo a cuatro vertientes

jack rafter: viga pequeña

jamb: jamba

joist: cabio

kerf: corte (que hace la sierra en la madera)

knots: nudos

ledger: solera sobre la que se apoyan las almojayas de un andamio

ledger strip: tira de madera clavada a lo largo de la superficie inferior de la viga maestra para sostener a los cabios

level: horizontal

lintel: lintel

medullary rays: rayos medulares

MAINTENANCE MECHANICS: Carpentry Terms

MECÁNICA DE MANTENIMIENTO: Terminología de Carpintería

miter joint: junta a inglete

mortise: mortaja, cotana

mullion: mainel

nail-set: punzón para claves

o.c.: en centro: medida de intervalo para largueros, cabrios, etc. en el edifício desde el centro de un miembro al centro de etro miembro

pitch: grado de inclinación (del techo)

pith: médula

plate: vigo horizontal

plumb: vertical, a plomo

plumb bob: plomada

plywood: madera contrachapada

rabbet: rebajo

radial: radial

rafter: cabrio, alfarda

ribbon: listón, cinta

ridge: arista

ridge board: caballete, viga fija

rise: aumento

run: corrida

shake: tipo de tejamanil (Cuba: tejamani) hecha (formada) mediante la separación en la madera entre los anillos anuales, a lo largo de un tronco

sill: solera, umbral

sill plate: miembro horizontal sujetado a pared de albañilería

MAINTENANCE MECHANICS: Carpentry Terms

MECÁNICA DE MANTENIMIENTO: Terminología de Carpintería

sliding T bevel: falsa escuadra en "T", corrediza

soffit: intradós, sofito

sole plate: solera inferior

solid bridging: entrelace fuerte

span: vacío, distancia entre dos paredes opuestas

steel square or try square: escuadra de comprobación

stud: larguero

tail joist: cabio sostenido por viga maestra en un extremo y por brochal en el otro extremo

trimmer: cabio

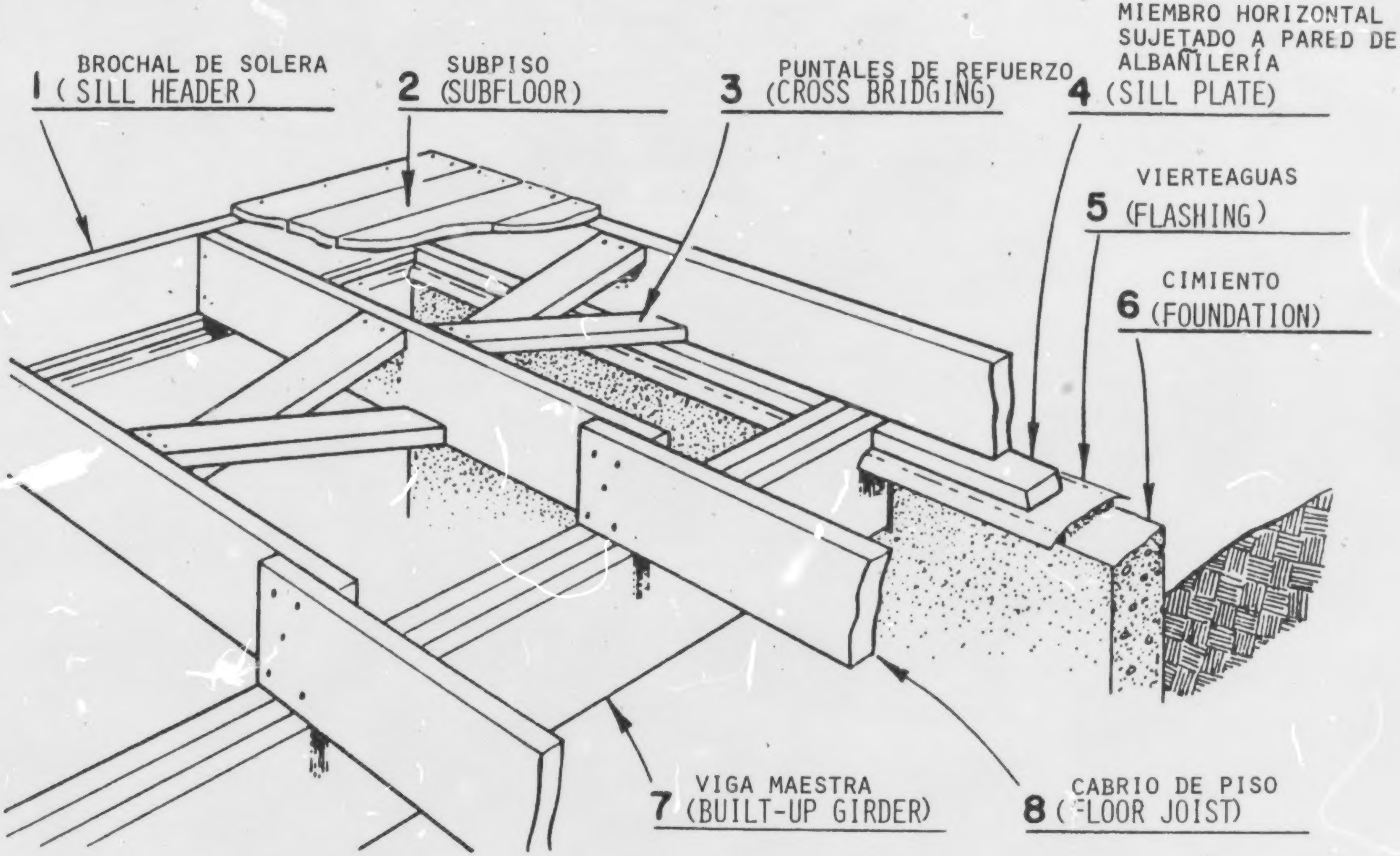
truss: armazón

valley: limahoya

warp: curvatura

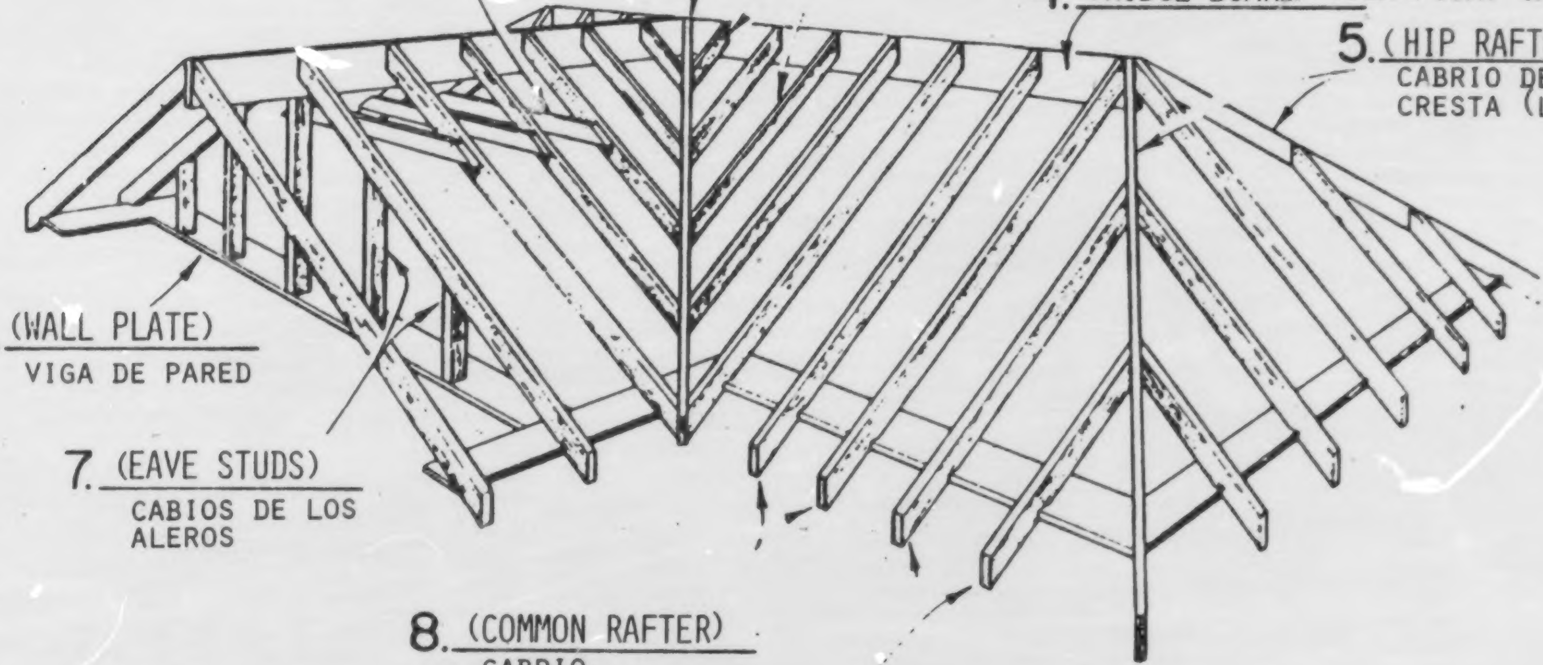
MIEMBROS DE PISO Y SOLERA

(FLOOR AND SILL MEMBERS)


BROCHAL DE SOLERA
1 (SILL HEADER)
SUBPISO
2 (SUBFLOOR)
PUNTALES DE REFUERZO
3 (CROSS BRIDGING)
MIEMBRO HORIZONTAL SUJETADO A PARED DE ALBAÑILERÍA
4 (SILL PLATE)
VIERTEAGUAS
5 (FLASHING)
CIMIENTO
6 (FOUNDATION)
VIGA MAESTRA
7 (BUILT-UP GIRDER)
CABRIO DE PISO
8 (FLOOR JOIST)

MIEMBROS DE TECHUMBRE

(ROOFING MEMBERS)



1. (VALLEY RAFTER) CABRIO DE LA LIMAHOYA

2. VIGA CENTRAL (COLLAR BRACE)

3. (VALLEY JACKS) CABIO QUE SE EXTIENDE DE LA CABALLETE AL CABRIO DE LIMAHOYA

4. (RIDGE BOARD) VIGA FIJA, CABALLETE

5. (HIP RAFTER) CABRIO DE LA CRESTA (LIMATESA)

6. (WALL PLATE) VIGA DE PARED

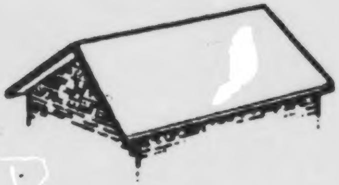
7. (EAVE STUDS) CABIOS DE LOS ALEROS

8. (COMMON RAFTER) CABRIO

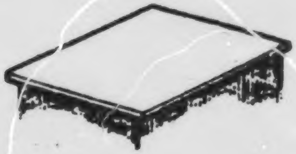
9. (HIP JACK) CABRIO QUE SE EXTIENDE DESDE LA VIGA HORIZONTAL HASTA EL CABRIO DE LA CRESTA (LIMATESA)

ESTILOS DE TECHA

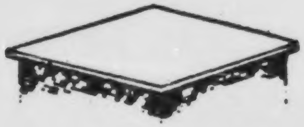
(ROOF STYLES)



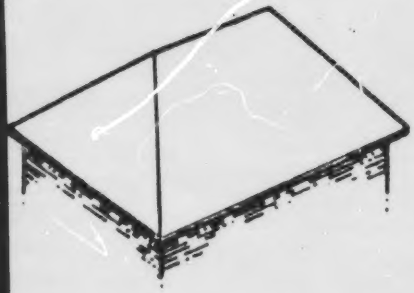
DE DOS AGUAS
1. (GABLE)



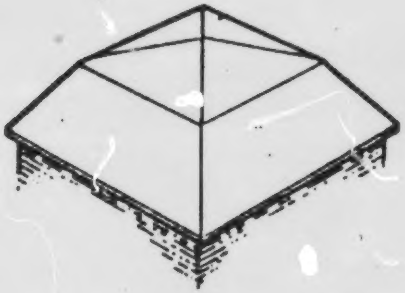
DE UNA SOLA VERTIENTE
2. (SHED)



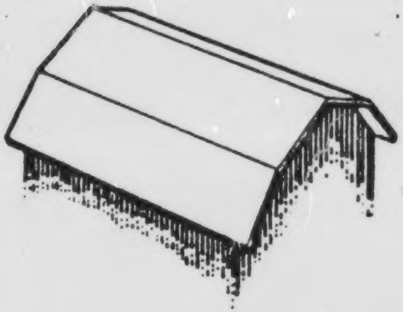
AZOTEA
3. (FLAT)



A CUATRO VERTIENTES
4. (HIP)



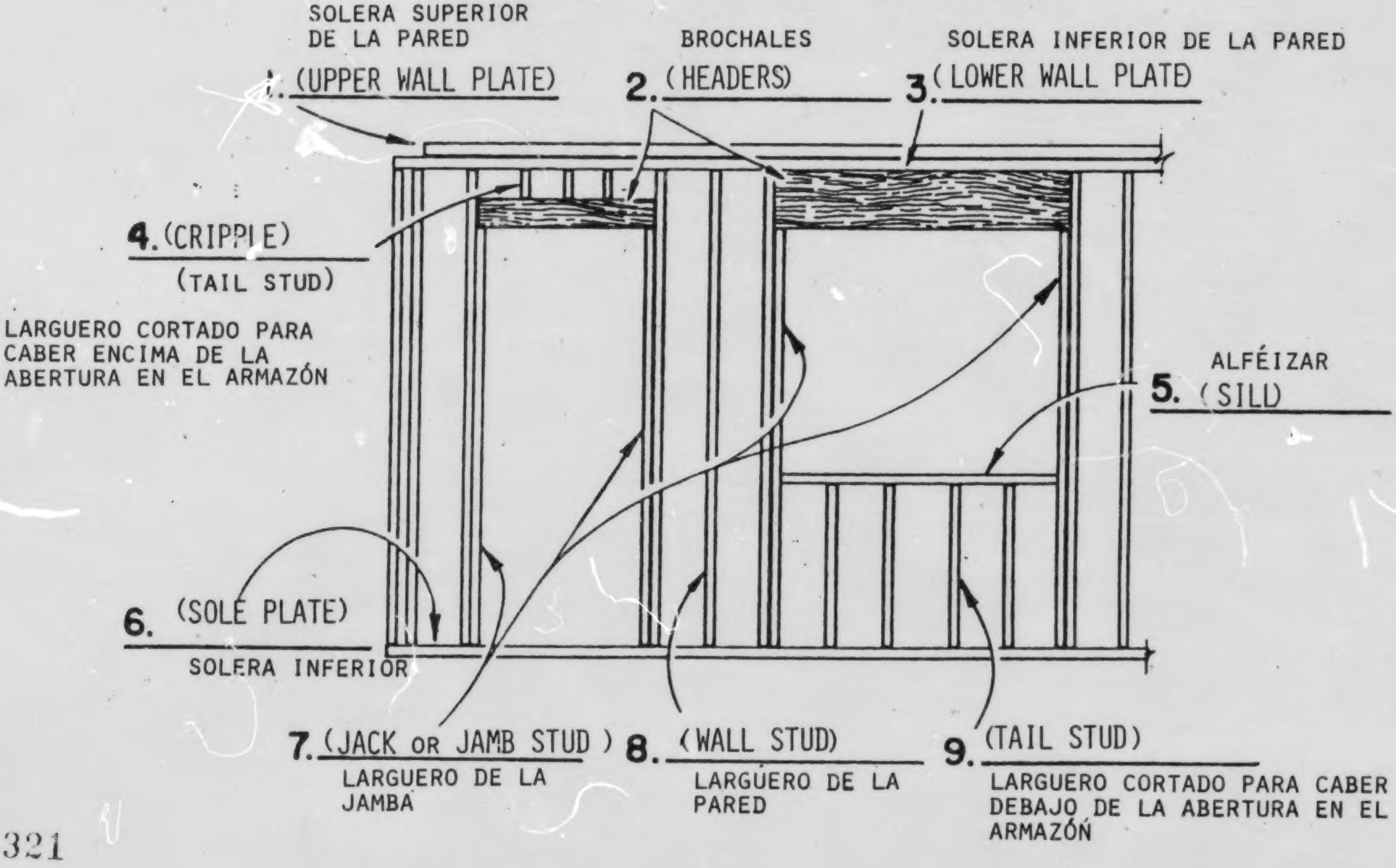
MANSARDA
5. (MANSARD)



HOLANDESA
6. (GAMBREL)

MIEMBROS DEL ARMAZÓN DE PARED

(*WALL FRAMING MEMBERS*)


SOLERA SUPERIOR DE LA PARED
1. (UPPER WALL PLATE)
BROCHALES
2. (HEADERS)
SOLERA INFERIOR DE LA PARED
3. (LOWER WALL PLATE)
4. (CRIPPLE)
(TAIL STUD)
LARGUERO CORTADO PARA CABER ENCIMA DE LA ABERTURA EN EL ARMAZÓN
ALFÉIZAR
5. (SILL)
6. (SOLE PLATE)
SOLERA INFERIOR
7. (JACK OR JAMB STUD)
LARGUERO DE LA JAMBA
8. (WALL STUD)
LARGUERO DE LA PARED
9. (TAIL STUD)
LARGUERO CORTADO PARA CABER DEBAJO DE LA ABERTURA EN EL ARMAZÓN

MAINTENANCE MECHANICS: Carpentry Equipment and Tools

MECÁNICA DE MANTENIMIENTO: Equipo y Herramientas de Carpintería

bit, auger: barrena espiral

bit, expansion: barrena de expansión (ajustable)

bolt, toggle: tornillo articulado

brace, bit: berbiquí

carpenter's measuring stick: metro de carpintero

carpenter's pencil: lápiz de carpintero

clamps, wood: tornillo-prensa para madera

cold chisel: cortafrío

drawknife: cuchilla (desbastadora) de dos mangos

drill, twist: broca helicoidal

hammers, claw: martillo de orejas

hatchet, claw: hachuela de uña

jigsaw: sierra caladora

jointer: cepillo mecánico, juntera

ladder: escala

level, builder's: nivel para constructor (de anteojo corto)

mallets: mazos

mitre boxes: cajas de ingletes

nail set: punzón para clavos

pinch bar or crowbar: alzaprima, pata de cabra

plane, power/hand: cepillo, mecánico/de mano

planer, thickness or surfacer: cepilladora

plumb bob: plomada

MAINTENANCE MECHANICS: Carpentry Equipment and Tools

MECÁNICA DE MANTENIMIENTO: Equipo y Herramientas de Carpintería

pounding tools: hammers, mallets, etc.: herramientas de golpear: martillos, mazos, etc.

press, drill: prensa taladradora

press, power: prensa mecánica

router, portable: moldeadora, portátil

sander, belt/stroke: lijadora, de cinta sin fin

saw, backsaw: sierra de costilla

saw, band: sierra sinfín (de cinta)

saw, circular: sierra, circular

saw, compass: sierra de contornear

saw, coping: sierra caladora

saw, portable/power: sierra, portatíl/mecánica

saw, radial arm: sierra, circular (de brazo radial)

saw, saber: sierra, de vaivén

saw, scroll/stroke: sierra, de marquetería/carrera

saw, straight-back: sierra, recta

screw, flat-head; slotted: tornillo, de cabeza perdida, de cabeza ranurada

screw, lag: tornillo, de cabeza cuadrada (tirafondo)

screw, phillip-head: tornillos, de cabeza Phillips (ranurada en cruz)

screw, round-head: tornillo, de cabeza redonda

scriber/divider: punta de trazar/compás de medir

sliding "T" bevel: falsa escuadra en "T" (corrediza)

square, combination: escuadra, combinada

MAINTENANCE MECHANICS: Carpentry Equipment and Tools

MECÁNICA DE MANTENIMIENTO: Equipo y Herramientas de Carpintería

square, framing or steel: escuadra de hierro

square, try and miter: escuadra, de comprobación y de ingletes

stapler or tacker: engrampador o calvadora

trammel points: puntas de trabar

trowel: llana, paleta, cuchara, fratás: según su forma y uso.

vises: prensas de tornillo

wood chisel: formón

wood gouge: gubia para madera

woodmarking gage: gramil para madera

wrenches: llaves (de tuerca)

MAINTENANCE MECHANICS: Plumbing Terms

MECÁNICA DE MANTENIMIENTO: Terminología de Plomería

anti-siphon trap: tubo antisifonaje

basement water main: tubería principal del agua

black pipe: tubo negro

bull head tee: tubo en forma de T con cabeza abultada

bushing: codo doble

cap: tapa

cast iron pipe: tubo de fundición

check valve: válvula de retención

cleanouts: limpias

close nipple: niple de rosca exterior

commode: excusado

copper tubing: tubería de cobre
Advantage: ventaja
1. no se oxida
2. se encorva
3. resiste al peso y a las temperaturas frías

Disadvantage: desventaja
1. el precio alto de instalación
2. se extende mas de hierro o acero

coupling: acoplamiento

crosses: cruces

die: troquel

DWU: abreviatura de sistemas "Drain-Waste-Unit"("instalación de dren y desagüe ")
elbow: codo

fitting: accesorios

galvanized pipe: tubería galvanizada

MAINTENANCE MECHANICS: Plumbing Terms

MECÁNICA DE MANTENIMIENTO: Terminología de Plomería

gate valve: válvula de compuerta

globe valve: válvula esférica

I.D.: diámetro interior

"long pipe": tubo de hierro forjado y acero

"loop vent": salida doble

main: tubería maestra

nipple: niple

oakum: estopa

O.D.: diámetro exterior

pipe dope: mastico para tubos

P-trap: bombillo inodoro con entrada vertical y salida horizontal

return elbow: tubo en ángulo de 180 grados

riser: tubería vertical

scale: acumulación de materias en el interior de la tubería

shoulder nipple: niple con espacio pequeño entre las roscas

siphon: sifón

siphonage: sifonaje

snake: herramienta en forma de varillas o cable que se usa para destancar tubos

soil stack: bajada vertical de aguas negras

sweating: (1) soldadura o sobresoldadura de metales
(2) condensación resultando de aire húmedo en contacto con tubo frío

tank nipple: niple para tanques

tap: (1) canilla, espita
(2) herramienta para cortar roscas internas

MAINTENANCE MECHANICS: Plumbing Terms

MECÁNICA DE MANTENIMIENTO: Terminología de Plomería

tee: tubo en "T"

threads: roscas, filetes

union: unión

waste stacks: bajada vertical que recibe la descarga de aparatos pequeños (aparatos sanitarios salvo los excusados)

water hammer: golpe de ariete (en tuberías de agúa)

wet vent: tubos de paso que se usa como tubo de desagüe debajo del aparato y como tubo de escape encima de eso punto

wye (Y): tubo en "Y"

yoke vents: tubos de paso que se colocan a intervalos de varios pisos para descargar presión de aire

MAINTENANCE MECHANICS: Plumbing Equipment and Tools

MECÁNICA DE MANTENIMIENTO: Equipo y Herramientas de Plomería

air compressor and attachments: compresor de aire y accesorios

augers, hand: barrenas, de mano

caulking and packing irons: cincel de calafatear y cincel de empacar

chalk line: cordel entizado

chisels, assorted: cinceles, surtidos

combination square: escuadra combinada

dividers or trammels: compases de dividir

electric arc welder: soldadora de arco, electric

files, assorted: limas, surtidas

flaring tool and block: abocinador

folding rule: metro plegadizo

hammers, assorted: martillos, surtidos

hand drills and bits: taladros y barrenas de mano

hand hacksaw: sierra para metales, de mano

hand pipe threaders: roscadoras de tubos, de mano

hand pipecutters and reaming tools: cortatubos de mano y herramientas de escariar (herramientas escariadoras)

hand saws: sierras de mano

ladders: escalas

oxyacetylene torch: soplete oxiacetilénico

pedestal and bench grinders: afiladora de pedestal y amoladora de banco

pipe taps: terrajas para tubos

MAINTENANCE MECHANICS: Plumbing Equipment and Tools

MECÁNICA DE MANTENIMIENTO: Equipo y Herramientas de Plomería

pipe-threading dies: troqueles roscados

pipe vise: tornillo de banco para tubos

pliers, assorted: pinzas, surtidas

plumb bob: plomada

portable air or electric drills: taladros portátiles: neumáticos o eléctricos

portable power saws: sierras mecánicas portátiles

power rodding equipment: equipo de desatancar, mecánico

powered pipe-cutters, threaders and reamers: cortatubos mecánicos, roscadoras mecánicos de tubos, escariadores de mecánicos tubos

propane torch: antorcha de propano

punches, assorted: punzones, surtidos

retractable steel measuring tapes: cintas para medir, de acero, retractables

screwdrivers, assorted: destornilladores, surtidos

soldering irons: hierros para soldar

spirit level: nivel de burbuja, nivel de aire

spring-type tubing bender: curvadora de tubería, tipo resorte

strap wrench: llave de correa

swaging tools: herramientas de estampa

tube cutter or reamer: escariador

wrenches, assorted: llaves de tuerca, surtidos

MAINTENANCE MECHANICS TECHNICAL TERMS

ENGLISH-LAOTIAN LEXICON

CAREER DEVELOPMENT CENTER
SCHOOL OF TECHNICAL CAREERS
SOUTHERN ILLINOIS UNIVERSITY
CARBONDALE, ILLINOIS

MAINTENANCE MECHANICS TECHNICAL TERMS

ENGLISH-LAOTIAN LEXICON

MASAKO T. SHIN, CURRICULUM SPECIALIST, STC, SIU-C

TRANSLATED BY

SOMCHAI THIPKHOSITHKUN

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ARDEN L. PRATT, DEAN
E. HOLLIS MERRITT, ASST. DEAN
LARRY HEPBURN, CENTER DIRECTOR

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MAINTENANCE MECHANICS: Air Conditioning and Heating Terms

absolute humidity: ຈຳນວນຄວາມຊຸ່ມໃນອາກາດ.

absolute pressure: ຄວາມກົດດັນທີ່ອ່ານຕາມເຄື່ອງວັດບວກກັນກັບຄວາມ
ກົດດັນຂອງບັນຍາກາດ.

absolute temperature: ອຸນຫະພູມວັດຈາກສູນ (0°) ອົງສາທີ່ແທ້ຈິງ.

absolute zero temperature: ອຸນຫະພູມທີ່ເຮັດໃຫ້ໂມເລກຸນຢຸດເຄື່ອນໄຫວ
(-460 F)

air cleaner: ເຄື່ອງກອງ (ກັນ) ຝຸ່ນ.

air cooled condenser: ຄວາມຮ້ອນເກີດຈາກຄວາມກົດດັນຜ່ານທີ່ຕິດໄປຕົ
ພາ. (ຂົດ) ນ້ອຍໆ ເພື່ອລະບາຍຄວາມຮ້ອນໂດຍໃຊ້ລົມ.

air sensing thermostat: ໂຕວັດອຸນຫະພູມທຳໜ້າທີ່ປິດເປີດໄຟຕາມທີ່
ຕັ້ງເອົາໄວ້.

ambient temperature: ອຸນຫະພູມລອບຂ້າງຂອງສິ່ງຂອງ.

atmospheric pressure: ຄວາມກົດດັນຂອງບັນຍາກາດ.

atomize: ການເຮັດໃຫ້ຂອງແຫຼວແຍກຕົວອອກເປັນລະອອງ.

automatic defrost: ການລະລາຍນ້ຳແຂງຢ່າງອັດຕະໂນມັດ.

automatic expansion valve (AEV): ຄວາມກົດດັນຄວບຄຸມໂດຍໃຊ້ລີ້ນ
(valve).

bath: ນ້ຳຢາໃຊ້ສຳລັບລ້າງ ຫຼື ຮັກສາອຸນຫະພູມລະດັບນຶ່ງ.

bimetal strip: ເຄື່ອງຄວບຄຸມອຸນຫະພູມໃຊ້ໂລຫະສອງຊະນິດ.

bleed valve: ລີ້ນທີ່ປິດມີຮູນ້ອຍເຮັດໃຫ້ຂອງແຫຼວໄຫຼຜ່ານອອກມາໄດ້
ທີລະນ້ອຍ.

boiling temperature: ອຸນຫະພູມນ້ຳຮ້ອນ (ເດືອດ).

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Boyle's Law: ກົດຂອງບອຍ. ປະລິມາດຂອງກາສ ຈະປ່ຽນໄປຕາມຄວາມກົດດັນ ຖ້າອຸນຫະພູມຢູ່ກັບທີ່.
calorie: ໜ່ວຍວັດຄວາມຮ້ອນ.

capacitor: ສ່ວນປະກອບຂອງໝໍ້ໄຟ. ສຳລັບເກັບກະແສໄຟ ໄວ້ໃຊ້ເມື່ອຕ້ອງການ.
capillary tube: ຫຼອດທີ່ມີໜ້າທີ່ຄວບຄຸມນ້ຳຢາເຮັດຄວາມເຢັນ.

celsius: ພາສາເຢຍຣະມັນ ສຳລັບເຊັນຕີເກຣດ

centigrade scale: ລະບົບວັດອຸນຫະພູມທີ່ໃຊ້ ເຊັນຕີເກຣດເຕີ.

centimeter: ເຊັນຕີເມດເຕີ .3937 ນີ້ວ = 2.54 ເຊັນຕີເມດເຕີ.

Charles' Law: ກົດຂອງ Charles ປະລິມາດຂອງກາສ ຈະປ່ຽນໄປຕາມອຸນຫະພູມ ຖ້າຄວາມກົດດັນເທົ່າເກົ່າ.
check valve: ເຄື່ອງປິດໃຫ້ຂອງແຫຼວເຄື່ອນຜ່ານໄປໄດ້ທາງດຽວ.

compression: ການໃຊ້ຄວາມກົດດັນ ຄວາມດັນຈາກແຮງ ໄປເຮັດໃຫ້ຄວາມກົດດັນເພີ່ມຂຶ້ນ.
compressor: ສ່ວນປະກອບຂອງເຄື່ອງ ທີ່ມີໜ້າທີ່ປ້ຳຂອງແຫຼວໃນລະບົບເຮັດຄວາມເຢັນ.
compressor, hermetic: ຄອມເປຣດເຊີ ຊະນິດທີ່ໝໍ້ປັ່ນໄຟ ຕິດຕົວກັນເອງ.

condensate: ອາຍນ້ຳປ່ຽນຕົວເປັນຂອງແຫຼວ.

condensation: ການເຮັດໃຫ້ເກີດນ້ຳຈິບ ເມື່ອອຸນຫະພູມລົດລົງຕ່ຳກ່ວາຈຸດນ້ຳຄ້າງ.
condense: ປ່ຽນຈາກກາສເປັນນ້ຳ. (ຂອງແຫຼວ).

condenser: ສ່ວນປະກອບຂອງເຄື່ອງເຮັດຄວາມເຢັນ ສຳລັບລະບາຍຄວາມຮ້ອນ ແລະ ແຮງກົດດັນ ແລ້ວປ່ຽນສະພາບໃຫ້ເປັນຂອງແຫຼວ.
condenser comb: ຫວີ ສຳລັບຫວີ ຊີ່ເຫຼັກຂອງຄອນເດັນເຊີ (Condenser).

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condenser fan: ພັດລົມເປົ່າ Condenser.

control temperature: ເຄື່ອງມືຄວບຄຸມໝໍ້ໄຟ. ສຳລັບປິດເປີດເຄື່ອງ ເຮັດຕາມອຸນຫະພູມທີ່ຕັ້ງໄວ້.

convection: ການພາຄວາມຮ້ອນໂດຍການເຄື່ອນທີ່.

convection, forced: ການພາຄວາມຮ້ອນໂດຍອາໄສພັດລົມຫຼືປ້ຳ.

cooling tower: ຫ້ອງປະກອບທີ່ເຮັດໃຫ້ນ້ຳເຢັນໂດຍການລະເຫີຍ.

counterflow: ໄຫຼໄປທາງກົງກັນຂ້າມ.

"cracking" a valve: ເປີດບ່ອນ ປິດເປີດໃນທີ່ເທື່ອລະໜ້ອຍ.

cut-in: ການປິດລະບົບວົງຈອນຂອງອຸນຫະພູມ.

cut-out: ການເປີດລະບົບວົງຈອນຂອງອຸນຫະພູມ.

damper: ໂຕປັບອາກາດ.

dehumidifier: ເຄື່ອງມືສຳລັບໄຊ້ກຳຈັດຄວາມຊື້ນ.

detector leak: ເຄື່ອງມືສຳລັບກວດການຮົ່ວ.

dew point: ຈຸດນ້ຳຄ້າງ.

dichlorodifluromethane: ນ້ຳຢາເຫຼວໃຊ້ໃນເຄື່ອງທຳຄວາມເຢັນ ຮ້ອງສັ້ນໆ ວ່າ R-12.

drier: ເຄື່ອງມືລົດຄວາມຊື້ນ.

dry bulb: ເຄື່ອງວັດອຸນຫະພູມຮອບເຄື່ອງ.

dry bulb temperature: ອຸນຫະພູມທຳມະດາ.

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duct: ທໍ່ຫຼ ຫລອດ ທີ່ເຮັດໃຫ້ອາກາດເຂົ້າ ຫຼື ອອກ.

evaporation: ການປ່ຽນສະພາບຈາກຂອງແຫຼວເປັນອາຍ ຫຼື ກ໊າສ.

evaporative condenser: ເຄື່ອງມືທີ່ຈຸດນໍ້າເພື່ອໃຫ້ລະບົບ Condensar ເຢັນລົງ.

evaporator: ສ່ວນປະກອບຂອງເຄື່ອງ ເຮັດຄວາມເຢັນ ທີ່ນໍ້າຢາ ທີ່ລະເຫີຍ ຈິ່ງດູດ ຄວາມຮ້ອນອອກ.

evaporator coil: ເຄື່ອງມືເຮັດທໍ່ຄົດເປັນວົງໆ ຫຼືເລື່ອເຮັດໃຫ້ ນໍ້າຢາທີ່ຄວາມ ເຢັນລະເຫີຍ.

evaporator fan: ພັດລົມທີ່ເປົ່າ ເຄື່ອງປ່ຽນຄວາມຮ້ອນ Evaporator.

expansion valve: ເຄື່ອງມືທີ່ເຮັດໃຫ້ລະບົບທໍາຄວາມເຢັນ ຮັກສາຄວາມແຕກຕ່າງຂອງຄວາມກົດດັນ ລະຫວ່າງອຸນ ຫ.ພູມສູງ ແລະຕໍ່າ.

fahrenheit scale: ລະບົບ Fahrenheit.

flare: ການເຮັດໃຫ້ປາຍທີ່ບານອອກ. ເພື່ອໄວ້ຕໍ່ກັບສ່ວນປະກອບອື່ນໆ.

flue: ທາງເດີນຂອງອາກາດ

foam leak detector: ລະບົບທີ່ໃຊ້ນໍ້າຟອງສະບູ ຫຼືເລີບກວດຮອຍ ຮູ້ທີ່ກັນຮົ່ວ

freezing point: ຈຸດນໍ້າແຂງ.

freon: ນໍ້າຢາ ຫຼື ລົມໃສ່ໃນເຄື່ອງທໍາຄວາມເຢັນ.

gasket: ໃບເກີນກັນຮົ່ວ.

gas - noncondensible: ກ໊າສ ທີ່ບໍ່ສາມາດ ປ່ຽນເປັນຂອງແຫຼວ.

gauge, compound: ເຄື່ອງມືວັດຄວາມກົດດັນ ທັງສູງແລະຕໍ່າ.

gauge, high pressure: ເຄື່ອງມືວັດຄວາມກົດດັນສູງ.

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gauge, low pressure: ເຄື່ອງມືວັດຄວາມກົດດັນຕ່ຳ.

gauge manifold: ເຄື່ອງມືວັດຄວາມກົດດັນເກືອບທຸກຊະນິດ.

gauge, vacuum: ເຄື່ອງມືວັດຄວາມກົດດັນຕ່ຳກວ່າຄວາມກົດດັນຂອງບັນຍາກາດ.

heat of compression: ການປ່ຽນແຮງກົດດັນໃຫ້ມາເປັນຄວາມຮ້ອນ.

heat of fusion: ຄວາມຮ້ອນເກີດຂຶ້ນຕອນຂອງແຂງປ່ຽນສະພາບເປັນແຫ

hermetic motor: ໝໍ້ Compresser ທີ່ມີໝໍ້ເດີນເຄື່ອງຢູ່ໃນຕົວເອງ.

hermetic system: ລະບົບເຄື່ອງ ເຮັດຄວາມເຢັນທີ່ມີໝໍ້ແລ່ນເຄື່ອງຢູ່ຮ່ວມກັ Compressor.

high side: ສ່ວນປະກອບຂອງລະບົບ ເຮັດຄວາມເຢັນທີ່ມີຄວາມກົດດັນ ສູງ.

humidity: ຄວາມຊຸ່ມ.

Kelvin Scale (K): ການວັດແບບ Kelvin ຈຸດນ້ຳແຂງ 273.16° ຈຸດຟົດ 373.16°

latent heat: ຄວາມຮ້ອນແຝງເກີດຂຶ້ນຈາກການປ່ຽນສະພາບຂອງຂອງແຫຼ

liquid receiver: ບ່ອນເກັບນ້ຳຢາ ກໍລຶບໃຊ້ໃນລະບົບ ເຮັດຄວາມເຢັນ.

low side pressure: ຄວາມກົດດັນໃນລະບົບ ເຮັດໃຫ້ເຢັນລົງ.

melting point: ຈຸດລະລາຍ.

monochlorodifluoromethane: ນ້ຳຢາ ສຳລັບໃຊ້ເຄື່ອງເຮັດຄວາມເຢັນ ຮ້ອງວ່າ Freon 22. ຫຼື R 22 ມີສີຂາວ.

noncondensable gas: ກ໊າຊ ທີ່ບໍ່ປ່ຽນສະພາບ ຕາມຄວາມກົດດັນ ແລະອຸນຫະພູມ ທຳມະຊາດ.

pour point: ຈຸດອຸນຫະພູມຕ່ຳທີ່ສຸດ ທີ່ນ້ຳຈະໄຫລຜ່ານຮູອອກ.

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PSI: ຫຍໍ້ມາຈາກ Pounds Per Square Inch ເປັນໜ່ວຍວັດຄວາມກົດ

PSIA: ເປັນໜ່ວຍ P.S.I ວັດ Absolute Pressure.

PSIG: ເບິ່ງ Absolute Pressure.

psychrometer or wet bulb hygrometer: ເຄື່ອງວັດຄວາມຊຸ່ມສຳພັນ (Relativ
Humidity) ຂອງບັນຍາກາດ.
psychrometric chart: ຕະລາງບອກຄວາມສຳພັນລະຫວ່າງອຸນຫະພູມ ຄວາມ
ກົດດັນ ແລະ ຄວາມຊຸ່ມຢູ່ໃນອາກາດ.
purging: ການປ່ອຍທາດ ທີ່ຖືກກົດດັນ ອອກມາຈາກບາງສ່ວນ ຂອງເຄື່ອ
ເຮັດຄວາມເຢັນເພື່ອໃຫ້ຂອງຕິດຄ້າງຢູ່ໃນທໍ່ໃຫ້ໝົດ.
Rankin Scale: ລະບົບວັດອຸນຫະພູມເປັນ Absolute Fahrenheit
ກັບ - 460° F.
refrigerant: ນ້ຳຢາທີ່ໃຊ້ໃນລະບົບເຮັດຄວາມເຢັນ ເພື່ອດູດເອົາຄວາມ
ຮ້ອນອອກຈາກ Condenser.
relative humidity: ຄວາມຊຸ່ມສຳພັນ ຄື ສັດສ່ວນຂອງຈຳນວນລະອອງນ້ຳ
ທີ່ມີໃນອາກາດຫຼາຍທີ່ສຸດ ຕອນທີ່ອຸນຫະພູມຄືກັນ.
saturation: ຄວາມອີ່ມຕົວ.

sensible heat: ຄວາມຮ້ອນທີ່ເຮັດໃຫ້ອຸນຫະພູມປ່ຽນຂອງສິ່ງຂອງ.

specific gravity: ນ້ຳໜັກຂອງວັດຖຸປຽບທຽບກັບນ້ຳ.

specific heat: ຄວາມຮ້ອນທີ່ຕ້ອງໃຊ້ອຸ່ນວັດຖຸນຶ່ງກຣາມໃຫ້ຮ້ອນຂຶ້ນ 1°C

specific volume: ປະລິມາດຕໍ່ນຶ່ງໜ່ວຍຂອງວັດຖຸ.

squirrel cage: ພັດລົມທີ່ມີໃບພັດຂນານກັນ.

superheat: ອຸນຫະພູມຂອງອາຍນ້ຳເໜືອຈຸດເດືອດ ຂອງຂອງແຫຼວໃນຄວາມ
ກົດດັນອັນດຽວກັນ.

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sweating: ການເຮັດໃຫ້ເປັນຂອງເຫຼວ ຂອງຄວາມຊຸ່ມ ຈາກອາກາດທີ່ເຢັນ.

thermostatic expansion valve: ເຄື່ອງຄວບຄຸມໂດຍໃຊ້ອຸນຫະພູມ ແລະຄວາມກົດດັນພາຍໃນ Evaporator Coil.

ton of refrigeration: ໜ່ວຍເຄື່ອງເຮັດຄວາມເຢັນ ຕັນ.

vacuum: ການລົດຄວາມກົດດັນ ຕ່ຳກວ່າຄວາມກົດດັນຂອງບັນຍາກາດ.

vapor pressure: ຄວາມກົດດັນທີ່ຢູ່ຈຸໆ ບໍ່ວ່າຈະເປັນອາຍນ້ຳ ຫຼື ກາສ.

vapor, saturated: ສະພາບຂອງອາຍນ້ຳ ທີ່ເຮັດໃຫ້ກັ່ນຕົວເປັນຢອດນ້ຳ ຕອນອຸນຫະພູມຂອງອາຍນ້ຳລົດລົງ.

viscosity: ຄວາມໜຽວ.

wet bulb: ເຄື່ອງມືໃຊ້ວັດຄວາມຊຸ່ມຊື່ນ.

MAINTENANCE MECHANICS: Carpentry Terms

annual rings: ເສັ້ນອ້ອມຂອງຕົ້ນໄມ້ ທີ່ຈະແຈງໃຫ້ເຫັນການເຕີບໂຕເປັນປີໆ.

balloon framing: ໂຄງຮ່າງຂອງເຮືອນສອງຊັ້ນ.

bearing posts: ຕ້ານຕັ້ງຕົງຂອງເສົາ ຫຼືເສົາ ເຊິ່ງພື້ນຖານຂອງຕອນລຶກ.

bevel square: ເຄື່ອງມືວາດມຸມຕ່າງໆ.

bevel: ເຄື່ອງວັດ ຫຼື ຫາມຸມ.

blemish: ໄມ້ທີ່ເສັຽຮູບຊົງ.

block bridging: ໄມ້ໜາໄວ້ຕອກປະສານກໍ່ທີ່ເຮັດໃຫ້ພື້ນໄມ້ແຂງແຮງຂຶ້ນ.

brace: ການໄວ້ແຜ່ນໄມ້ທີ່ຈາກຫົວມຸມ ຕ້ານມຶ່ງໄປຫາຫົວມຸມອີກ ຕ້ານນຶ່ງທີ່ຕົງຂ້າມ.

braced frame: ການໄວ້ໄມ້ເຮັດເສົາຕ້ານຂ້າງ ເປັນໂຄງຮ່າງໂດຍໄວ້ເສົາກັບຄານ.

bridging: ວິທີການປະສານຄານລະຫວ່າງຄານຮັບນ້ຳໜັກຂອງພື້ນໄມ້ ເພື່ອຊ່ວຍໃຫ້ນ້ຳໜັກກະຈາຍໄປທົ່ວໆ.

carpenter's rafter and framing square or steel square: ເຄື່ອງມືວັດຂອງຊ່າງໄມ້ ສໍາລັບວັດເຣຂາຄະນະປະງານທີ່ທໍາລົງເລີ່ມຕົ້ນ.

check: ເສັ້ນຕັດວົງປີຂອງຕົ້ນໄມ້.

collar beam: ຄານລະຫວ່າງມຸມຂອງຫຼັງຄາຮູບໜ້າຈົ່ວ.

combination square: ເຄື່ອງວັດຂອງເຄື່ອງມືຊ່າງໄມ້ທີ່ໃຊ້ຫຼາຍກ່ວາອັນອື່ນ.

crosscut saw: ເລື່ອຍຕັດໄມ້ ສໍາລັບຕັດທາງຂວາງກັບລາຍໄມ້.

dado: ເປັນຊ່ອງຫວ່າງລະຫວ່າງແຜ່ນໄມ້.

MAINTENANCE MECHANICS: Carpentry Terms (cont.)

dimension yard lumber: ໄມ້ມີຄວາມໜາ ຈາກສອງເຖິງຫ້ານິ້ວ ທັງມີ ຄວາມກວ້າງຫຼາຍຂນາດ.

dormer: ບ່ອນ ຍື່ນອອກມາ ຈາກ ຫຼັງຄາ ທີ່ມີ ໜ້າຕ່າງນຳ.

eaves: ຕອນ ຂ້າງ ຂອງ ຫຼັງຄາ ທີ່ຍື່ນອອກໄປ ເກີນ ເສົາ ຕອນ ຂ້າງ.

fiber saturation: ໄມ້ ທີ່ ແຫ້ງ ແລ້ວ.

flashing: ແຜ່ນ ເຫຼັກ ບາງໆ ໃຊ້ ປິດມຸມ ເພື່ອກັນ ນ້ຳ ເຂົ້າ.

furring: ການ ຕີໄມ້ ເປັນ ແຜ່ນ ບາງໆ ໃຫ້ ຍຶດ (ຈັບ) ຂອງແຜ່ນ ໄມ້ອັດ (plywood).

gable: ຫຼັງຄາ ໜ້າ ຈົ່ວ.

gambrel roof: ຫຼັງຄາ ລາດ ລົງ ທີ່ມີ ສາຍມຸມ.

girder: ສ່ວນ ທີ່ ຮອງຮັບ ຄານຂອງພື້ນ.

grain: ລາຍໄມ້.

gusset: ແຜ່ນເຫຼັກທີ່ຕິດກັບມຸມ ເຮັດໃຫ້ໂຄງສ້າງແຂງແຮງ.

header: ຄານໄມ້ ທີ່ ຕັ້ງ ເທິງ ພື້ນ ຊຸມ.

hip: ໄຫຼ່ ຂອງ ຫຼັງຄາ.

hip jack rafter: ຄານ ພາດໄຫຼ່ຂອງ ຫຼັງ ຄາ. (ໃຫ້ເບິ່ງຮູບ).

hip rafter: ໄຫຼ່ຂອງ ຄານ ໄມ້ ຂອງຫຼັງ ຄາ.

hip roof: ຫຼັງ ຄາ ລາດ ລົງ ທີ່ ຂ້າງ.

MAINTENANCE MECHANICS: Carpentry Terms (cont.)

jack rafter: ຄານພາດໄສ່ລຽງມຸມ.

jamb: ຕັນຂ້າງ ຂອງປະຕູ.

joist: ຄານໄມ້ ຂນານກັນ ຫຼາຍອັນ ທີ່ຮັບຍົກພື້ນ.

kerf: ຮອຍຕັດຕື້ນໆ ເທິງໄມ້ ໂດຍໄຊ້ເລື່ອຍ.

knots: ປຸ່ມໄມ້ (ຕາໄມ້).

ledger: ບ່ອນປື້ນອອກມາຈາກເສົາ ທີ່ຮັບໄວ້ຂອງ.

ledger strip: ໄມ້ປື້ນອອກມາຈາກເສົາ.

level: ຣະດັບ.

lintel: ໄມ້ທາງຂວາງ ເທິງປະຕູ ຫຼື ປ່ອງຢ້ຽມ.

medullary rays: ເສັ້ນຂ້າງໃນ ຂອງລຳຕົ້ນ.

miter joint: ເຊື່ອງຈ່ວຍ ວັດມຸມ ຂອງຂໍ້ຕໍ່ໄມ້.

mortise: ຮ່ອງຫວ່າງຂໍ້ຕໍ່

mullion: ໄມ້ ຫຼື ເຫຼັກ ທີ່ແບ່ງປ່ອງຢ້ຽມ ອອກເປັນຫ້ອງໆ.

nail-set: ສລັກຕອກຫົວຕະປູ.

o.c.: ເປັນຣະຍະຫ່າງເທົ່າໆກັນ. (on center).

pitch: ຄວາມລາດ ຂອງຫລັງຄາ.

MAINTENANCE MECHANICS: Carpentry Terms (cont.)

pith: ແກນຂອງໄມ້.

plate: ແຜ່ນ.

plumb: ເທື່ງຣະດັບ.

plumb bob: ຕຸ້ມວັດຣະດັບ.

plywood: ແຜ່ນໄມ້ອັດ.

rabbet: ຮອຍຊ້າກ ຫຼື ຮອຍບາກ.

radial: ຣັສມີ.

rafter: ໄມ້ຈັນທັນ.

ribbon: ເສັ້ນແຜ່ນເຫຼັກບາງໆ.

ridge: ສັນຂອງຫຼັງຄາ.

ridge board: ສັນຂອງແຜ່ນໄມ້.

rise: ສ່ວນສູງຂອງຂັ້ນໄດ. ຫຼື ສ່ວນສູງຂອງຫຼັງຄາ.

run: ສ່ວນກວ້າງຂອງຂັ້ນໄດ ຫຼື ສ່ວນຍາວຂອງຫຼັງຄາ.

shake: ສ່ວນທີ່ແຕກ ຣະຫວ່າງວົງປີຂອງຕົ້ນໄມ້.

sill: ພື້ນຂອງປະຕູ ຫຼື ປ່ອງຢ້ຽມ.

sill plate: ແຜ່ນບ່ອນພື້ນປະຕູ ຫຼື ໜ້າຕ່າງ.

MAINTENANCE MECHANICS: Carpentry Terms (cont.)

sliding T bevel: ເຄື່ອງຕັ້ງມຸມ ມີຮູບຄ້າຍຕົວທີ (T).

soffit: ສ່ວນຂ້າງລ່າງ (ລຸ່ມ) ຂອງຊານ.

sole plate: ພື້ນທາງລຸ່ມຂອງຝາ.

solid bridging: ທີ່ພາດຢ່າງແໜ້ນ.

span: ຄວາມກວ້າງຂອງຫລັງຄາໜ້າຈົ່ວ ຈາກຝາຮອງຮັບຂອງຂ້າງ.

steel square or try square: ເຄື່ອງວັດມຸມ

stud: ທ່ອນໄມ້ສໍາລັບເຮັດຝາ.

tail joist: ຫາງທ່ອນໄມ້ທີ່ຍື່ນຜ່ານຝາອອກໄປ.

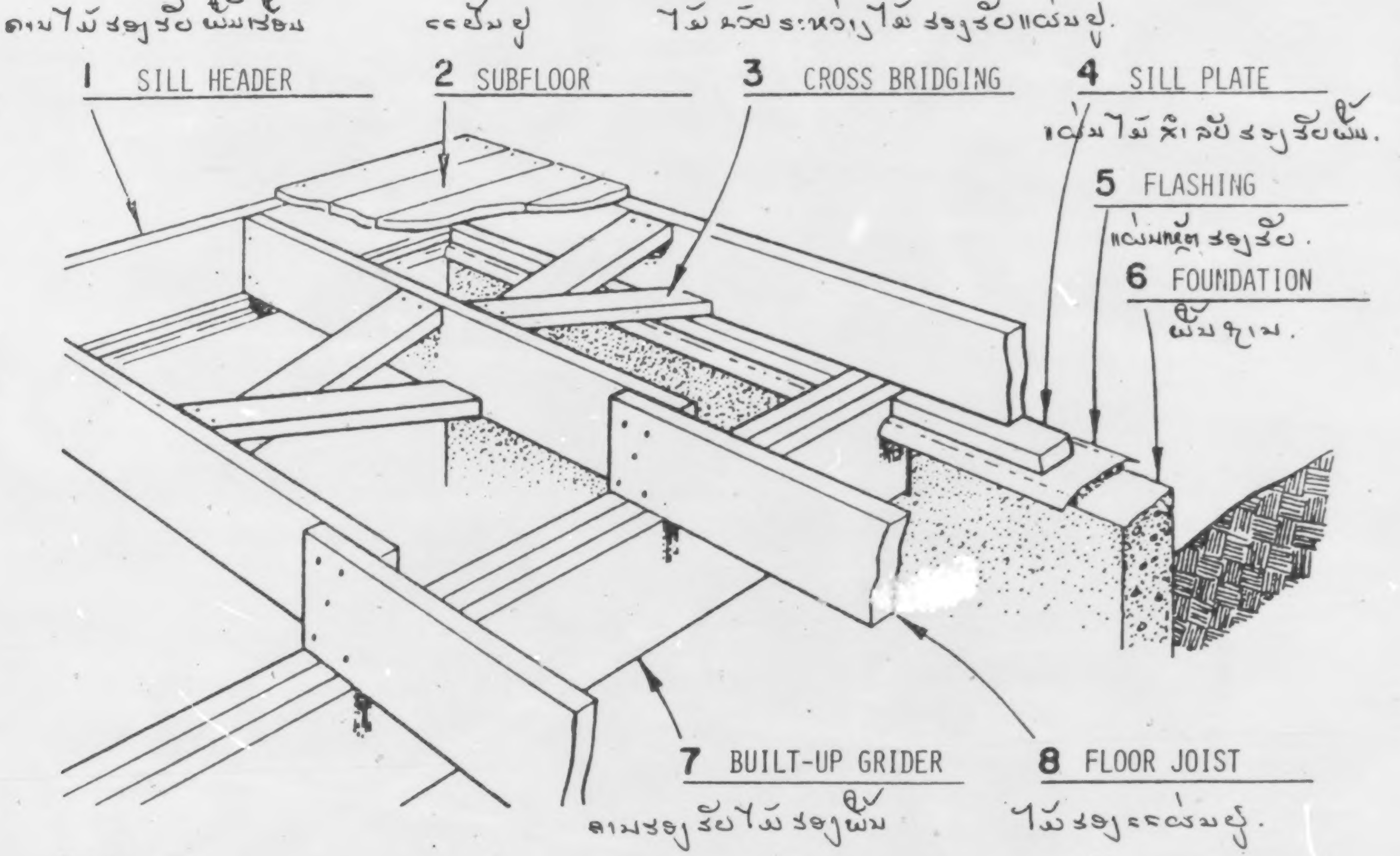
trimmer: ເຄື່ອງປະດັບ.

truss: ໂຄງໄມ້ ອອກແບບໃຫ້ມີໜ້າທີ່ຄໍ້າຄານອັນໃຫຍ່.

valley: ມຸມທີ່ເກີດຈາກຫລັງຄາລາດສອງຂ້າງ ເປັນເສັ້ນທາງລະບາຍນ້ຳຝົນ.

warp: ຄົດ ງໍ ບິດ.

FLOOR AND SILL MEMBERS


ຄານໄມ້ຮອງຮັບພື້ນເຮືອນ
1 SILL HEADER
ແປ້ນປູ
2 SUBFLOOR
ໄມ້ຂວັດຣະຫວ່າງໄມ້ຮອງຮັບແຜ່ນປູ.
3 CROSS BRIDGING
4 SILL PLATE
ແຜ່ນໄມ້ສໍາລັບຮອງຮັບພື້ນ.
5 FLASHING
ແຜ່ນກູ້ດຮອງຮັບ.
6 FOUNDATION
ພື້ນຖານ.
7 BUILT-UP GRIDER
ຄານຮອງຮັບໄມ້ຮອງພື້ນ
8 FLOOR JOIST
ໄມ້ຮອງແຜ່ນປູ.

ROOFING MEMBERS

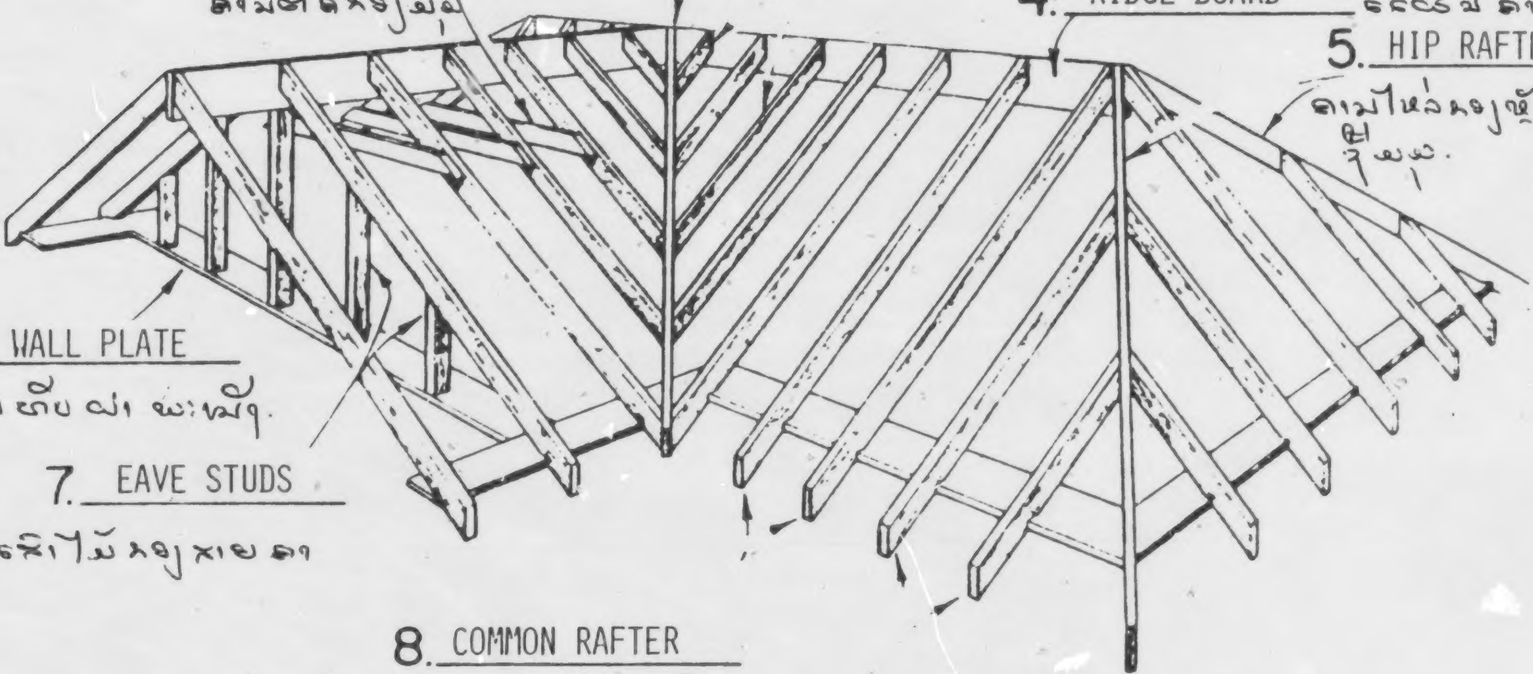
1. VALLEY RAFTER ຄານພາດຣະຫວ່າງຮ່ວງຫລັງຄາ.

2. COLLAR BRACE ຄານທໍ່ຄໍຂອງມຸມ

3. VALLEY JACKS ຄານພາດຕິ່ງຮ່ວງຂອງຫຼັງຄາ.

4. RIDGE BOARD ແປ້ນ ຄານເທິງ.

5. HIP RAFTER ຄານໄຫລ່ຂອງຫຼັງຄາ ຫຼືມຸມ.



6. WALL PLATE ແປ້ນທັບຝາ ພະໜັງ.

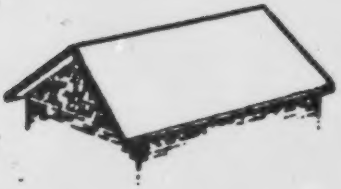
7. EAVE STUDS ເສົາໄມ້ຂອງຊາຍຄາ

8. COMMON RAFTER ຄານພາດແປ້ນ ຄານເທິງ

9. HIP JACK ຄານພາດຄານໄຫລ່ຂອງມຸມ.

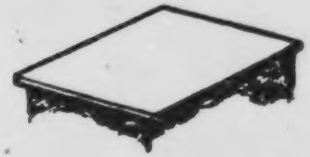
ROOF STYLES

ແບບຫຼັງຄາ.



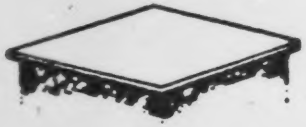
1. GABLE

ຫຼັງຄາໜ້າຈົ່ວ



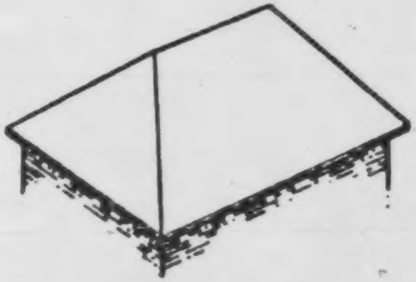
2. SHED

ຫຼັງຄາລາດລົງ



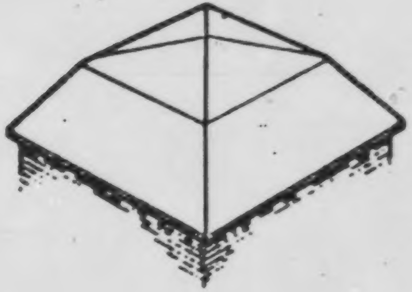
3. FLAT

ຫຼັງຄາພຽງ.



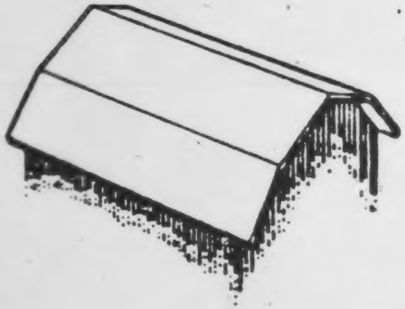
4. HIP

ຫຼັງຄາລາດລົງສີ່ທາງ.



5. MANSARD

ຫຼັງຄາລາດສອງພຸມ.

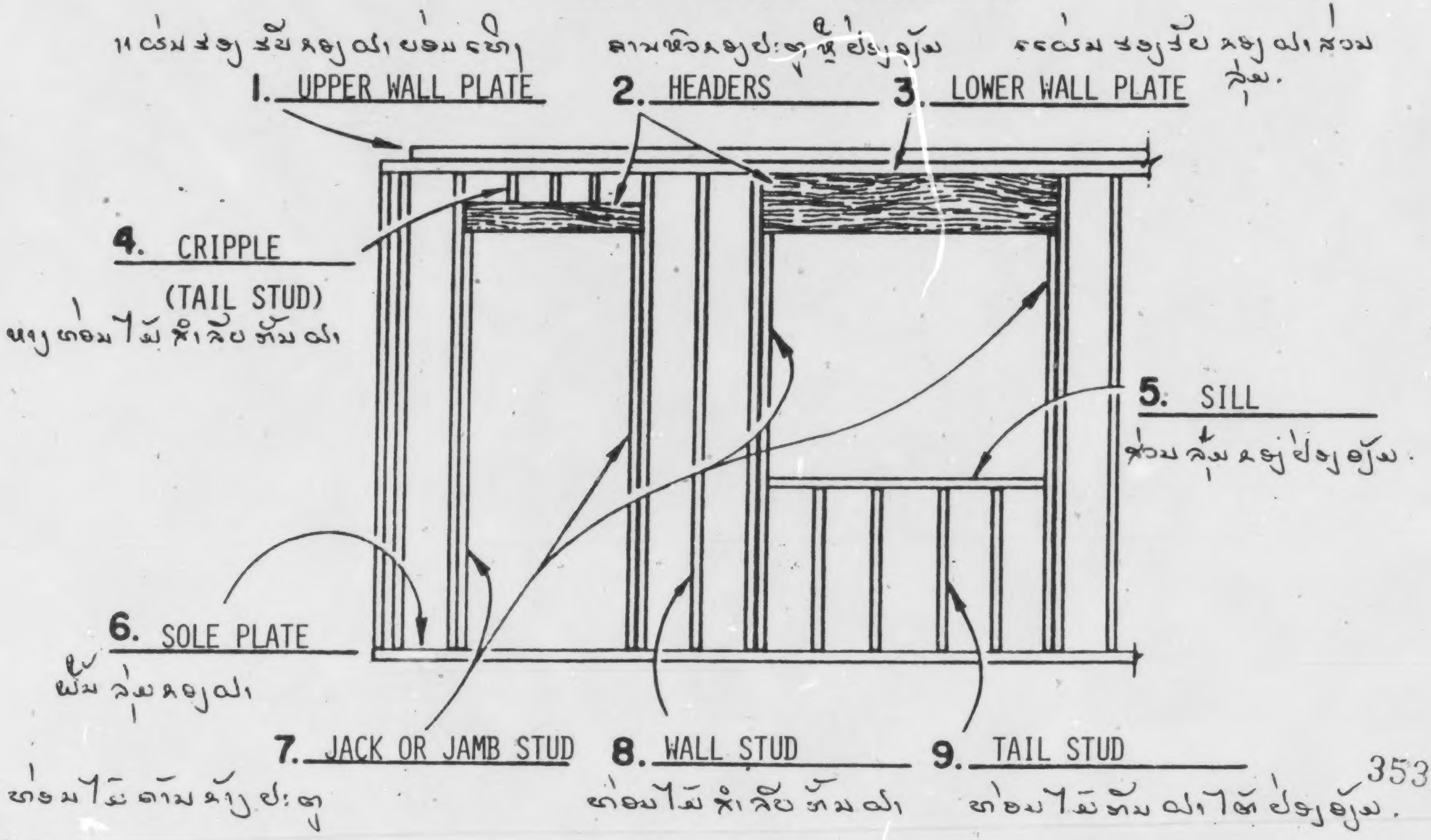


6. GAMBREL

ຫຼັງຄາລາດສາມພຸມ.

ສ່ວນປະກອບໂຄງສ້າງຂອງຝາ.

WALL FRAMING MEMBERS


ແປ່ນຮອງຮັບຂອງຝາບ່ອນເທິງ
1. UPPER WALL PLATE
ຂານຫົວຂອງປະຕູ ຫຼື ປ່ອງຢ້ຽມ
2. HEADERS
ແປ່ນຮອງຮັບຂອງຝາສ່ວນລຸ່ມ.
3. LOWER WALL PLATE
4. CRIPPLE
(TAIL STUD)
ທ່ຽງທ່ອນໄມ້ຄໍ້າລຽບກັບຝາ
5. SILL
ສ່ວນລຸ່ມຂອງປ່ອງຢ້ຽມ.
6. SOLE PLATE
ພື້ນລຸ່ມຂອງຝາ
7. JACK OR JAMB STUD
ທ່ອນໄມ້ຕັ້ງຂ້າງປະຕູ
8. WALL STUD
ທ່ອນໄມ້ຄໍ້າລຽບກັບຝາ
9. TAIL STUD
ທ່ອນໄມ້ກັບຝາໄຕ້ປ່ອງຢ້ຽມ.

MAINTENANCE MECHANICS: Carpentry Equipment and Tools

1. bit, auger: ສະວ່ານເຈາະ.
2. bit, expansion: ສະວ່ານເຈາະ ສໍາລັບ ຂຍາຍຮູ.
3. bolt, toggle: ນັອດ ຫົວດູ້ ສໍາລັບ ດຶງ.
4. brace bit: ສະວ່ານມື
5. carpenter's measuring stick: ເຄື່ອງວັດ ຂອງຊ່າງໄມ້.
6. carpenter's pencil: ດິນສໍ ຂອງຊ່າງໄມ້.
7. clamps, wood: ອັນຈັບໄມ້ ໃຫ້ໄມ້ເຂົ້າກັນ.
8. cold chisel: ສິ່ວ.
9. drawknife: ມີດ ທີ່ມີ ດ້າມ ຈັບ ສອງຂ້າງ.
10. drill, twist: ຫົວສະວ່ານ.
11. hammers, claw: ຄ້ອນ ທີ່ ມີ ບ່ອນ ຖອນ ຕະປູ ອອກມາ.
12. hatchet, claw: ຂວັນ.
13. jigsaw: ເລື່ອຍໃບແຄບ
14. jointer: ກົບໄມ້.
15. ladder: ໄມ້ພາດ ສໍາລັບ ປີນ.
16. level, builder's: ເຄື່ອງວັດ ລະດັບ
17. mallets: ຄ້ອນ ເປັນໄມ້.

MAINTENANCE MECHANICS: Carpentry Equipment and Tools (cont'd)

18. **mitre boxes**: ເຄື່ອງມືຕັດໄມ້ໃຫ້ເປັນມຸມ ທີ່ຕ້ອງການ.

19. **nail set**: ຕະປູ ເປັນຈຸດ.

20. **pinch bar or crowbar**: ເຫຼັກງັດ.

21. **plane, power/hand**: ເຄື່ອງມືຕັດສອຍໄມ້. ໃຊ້ໄຟຟ້າ ຫຼືມື.

22. **planer, thickness or surfacer**: ເຄື່ອງມືຕັດສອຍໄມ້ ສຳຣັບດ້ານ ໜ້າ ກັບດ້ານ ຂ້າງຂອງແຜ່ນໄມ້.

23. **plumb bob**: ລູກດິ່ງ.

24. **pounding tools**: hammers, mallets, etc. ຄ້ອນຕີ ຫຼາຍຢ່າງ.

25. **press, drill**: ສະວ່ານ ຊະນິດຕັດລົງຊື່.

26. **press, power**: ເຄື່ອງຕັດໄມ້ໃຫ້ເທົ່າ ໜາກັນ.

27. **router, portable**: ເຄື່ອງເຈາະ ຫຼື ແກະ ສະຫຼັກ.

28. **sander, belt/stroke**: ເຄື່ອງຝົນກະດາດຊາຍ.

29. **saw, backsaw**: ເລື່ອຍຕັດເຫຼັກທຳມະດາ.

30. **saw, band**: ເລື່ອຍເປັນເສັ້ນຍາວໆ.

31. **saw, circular**: ເລື່ອຍເປັນແຜ່ນກົມໆ.

32. **saw, compass**: ເລື່ອຍຕັດມຸມ.

33. **saw, coping**: ເລື່ອຍສຳລັບຕັດໃຫ້ເປັນວົງກົມໆ.

34. **saw, portable/power**: ເລື່ອຍຕັດຕົ້ນໄມ້.

MAINTENANCE MECHANICS: Carpentry Equipment and Tools (cont'd)

35. saw, radial arm: ເລື່ອຍຊະນິດທີ່ຕິດຢູ່ເທິງໂຕະໄວ້ຕັດໄດ້ຫຼາຍຢ່າງ.
36. saw, saber: ເລື່ອຍໄຟຟ້າ ສຳລັບຕັດແຜ່ນໄມ້ບາງໆ.
37. saw, scroll/stroke: ເລື່ອຍໄຟຟ້າ ຊະນິດລ້ຽວໄປມາໄດ້.
38. saw, straight-back: ເລື່ອຍຫາງຕົງ (ຊື່).
39. screw, flat-head; slotted: ຕະປູກຽວທຳມະດາ.
40. screw, lag: ຕະປູກຽວທີ່ມີຫົວ 4 ຫຼ່ຽມ.
41. screw, phillip-head: ຕະປູກຽວຫົວຈຸ້ນ.
42. screw, round-head: ຕະປູກຽວຫົວກົມ.
43. scriber/divider: ເຄື່ອງແບ່ງຈຸດໃຫ້ເທົ່າກັນ.
44. sliding "T" bevel: ເຄື່ອງວັດມຸມຕ່າງໆ.
45. square, combination: ເຄື່ອງວັດມຸມສາກ.
46. square, framing or steel: ເຄື່ອງມືຕັດມຸມສາກ.
47. square, try and miter: ເຄື່ອງວັດມຸມສາກ.
48. stapler or tacker: ການຕອກຕະປູໂດຍໃຊ້ເຄື່ອງມື.
49. trammel points: ວົງກົມ.
50. trowels: ເຄື່ອງມືຕັກປູນທາຝາ.
51. vises: ຂັນຈັບ.

MAINTENANCE MECHANICS: Carpentry Equipment and Tools (cont'd)

52. wood chisel: ສິ່ວໄມ້.

53. wood gouge: ໄມ້ເຈາະຮ່ອງໆ.

54. woodmarking gage: ລວດສໍາລັບຂີດເສັ້ນເທິງໄມ້.

55. wrenches: ກະແຈມື.

MAINTENANCE MECHANICS: Plumbing Terms

anti-siphon trap: ທໍ່ທີ່ຕິດຂໍ້ລັບ ເຮັດໃຫ້ນ້ຳຂັງ ເພື່ອປ້ອງກັນບໍ່ໃຫ້ນ້ຳໄຫລຄືນ.

basement water main: ທໍ່ນ້ຳ ເປັນທໍ່ເຂົ້າ ຈາກທໍ່ໃຫຍ່.

black pipe: ທໍ່ເຫຼັກ ທາສີດຳ ໃຊ້ເປັນທໍ່ອາກາດ.

bull head tee: ໄມ້ສາກ ຈະມີດ ປີກຍາວ.

bushing: ປອກ.

cap: ຝາປິດທໍ່ໃຫ້ຕັນ.

cast iron pipe: ທໍ່ເຫຼັກ ໃຊ້ລະບາຍນ້ຳເປື້ອນ.

check valve: ເຄື່ອງມື ປ້ອງກັນບໍ່ໃຫ້ນ້ຳໄຫລຄືນ.

cleanouts: ຮູທີ່ປິດເປີດໄດ້ ເທິງທໍ່ນ້ຳ. ຂໍລັບທຳຄວາມສະອາດ.

close nipple: ທໍ່ນ້ຳ ທີ່ມີກຽວ ຕລອດ.

commode: ຫົວສ້ວມ ທີ່ມີບ່ອນນັ່ງ.

copper tubing: ທໍ່ນ້ຳ ທີ່ເຮັດດ້ວຍທອງແດງ.

Advantage: ຈັດປຸງປີ່ນງານໄດ້

① - ບໍ່ເປັນໝຽງ ② - ງໍໄດ້ ③ ຕ້ານທານແຮງກະທົບ.

④ ເວລາອາກາດໜາວຫຼາຍບໍ່ຫັກ.

Disadvantage: ເຊັ່ງປຸງປີ່ນການໄດ້ ① ລາຄາແພງ.

② - ຂຍາຍຕົວຫລາຍກ່ວາເຫຼັກ.

coupling: ຂໍ້ຕໍ່ຂອງທໍ່ນ້ຳ.

crosses: ຂໍ້ຕໍ່ສີ່ທາງ.

MAINTENANCE MECHANICS: Plumbing Terms - (cont.)

die: ເຄື່ອງຕັດກຽວ.

DWU: ຄຳຫຍໍ້ ຣະບົບທໍ່ລະບາຍ. (Drain - Waste - Unit).

elbow: ຂໍ້ຕໍ່ທໍ່ລ້ຽວເປັນມຸມສາກ.

fitting: ຂໍ້ຕໍ່ທໍ່ນ້ຳຕ່າງໆ.

galvanized pipe: ທໍ່ນ້ຳທີ່ເຄືອບດ້ວຍດີບຸກກັນຂີ້ໝ້ຽງ.

gate valve: ທີ່ເປີດທໍ່ນ້ຳ.

globe vavle: ທີ່ເປີສທໍ່ນ້ຳ.

I.D.: ເສັ້ນຜ່ານສູນກາງຂ້າງໃນ.

"long pipe": ທໍ່ນ້ຳເຮັດດ້ວຍເຫຼັກ.

"loop vent": ບ່ອນຫາຍໃຈຂອງທໍ່ນ້ຳ. ກັບທໍ່ສ້ວມຢູ່ບ່ອນດຽວກັນ.

main: ທໍ່ລະບາຍນ້ຳ ທີ່ມີທໍ່ອື່ນໄຫຼເຂົ້າມາ.

nipple: ທໍ່ນ້ຳທີ່ມີກຽວສອງຂ້າງ.

oakum: ເສົ້າຊຸບຢາງກັນຮົ່ວ ໃຊ້ສຳລັບຕໍ່ທໍ່ນ້ຳ.

O.D.: ເສັ້ນຜ່ານສູນກາງວັດຈາກຂອບຂ້າງນອກ.

pipe dope: ນ້ຳຢາປູກາວ ສຳລັບທາກັນຮົ່ວ.

P-trap: ທໍ່ນ້ຳທີ່ຮູບເປັນຕົວພີ (P).

return elbow: ຂໍ້ຕໍ່ທໍ່ລ້ຽວກັບຄືນ.

wye (Y): ຂໍ້ຕໍ່ທີ່ມີສາມທາງ ມີຮູບຄືຕົວວາຍ (Y).

yoke vents: ທີ່ລະບາຍອາກາດ ລະຫວ່າງຊັ້ນຕຶກ.

MAINTENANCE MECHANICS: Plumbing Equipment and Tools

1. air compressor and attachments: ເຄື່ອງອັດແຮງລົມ ແລະ ເຄື່ອງມືປະກອບ.
2. augers, hand: ສະວ່ານມື.
3. caulking and packing irons: ເຄື່ອງມື ສຳລັບ ຢາ ຮູ ກັນ ຮົ່ວ.
4. chalk line: ເສັ້ນຕີ່ຂີດ.
5. chisels, assorted: ສິ່ວ.
6. combination square: ເຄື່ອງວັດມຸມສາກ.
7. dividers or trammels: ເຄື່ອງແບ່ງຈຸດໃຫ້ເທົ່າກັນ.
8. electric arc welder: ເຄື່ອງເຊື່ອມ (ຈອດເຫຼັກ).
9. files, assorted: ຕະໄບ.
10. flaring tool and block: ເຄື່ອງຂະຫຍາຍປາຍທໍ່ນ້ຳອອກ.
11. folding rule: ໄມ້ວັດແທກຊະນິດພັບໄດ້.
12. hammers, assorted: ຄ້ອນ.
13. hand drills and bits: ສະວ່ານມື ແລະ ຫົວສະວ່ານ.
14. hand hacksaw: ເລື່ອຍມື.
15. hand pipe threaders: ເຄື່ອງຕັດກຽວ (ໃຊ້ມືໝູນ).
16. hand pipecutters and reaming tools: ເຄື່ອງຕັດທໍ່ນ້ຳ ແລະ ເຄື່ອງ ຂະຫຍາຍຮູໃຫ້ກວ້າງອອກ.

MAINTENANCE MECHANICS: Plumbing Equipment and Tools (cont.)

17. hand saws: ເລື່ອຍມື.

18. ladders: ຂັ້ນໄດທ່າຍ.

19. oxyacetylene torch: ຫົວເຄື່ອງຈອດໄຊ້ກ໊າສ (Oxyacetyline).

20. pedestal and bench grinders: ບ່ອນຕັ້ງເຄື່ອງຝົນຢູ່ກັບພື້ນ.

21. pipe taps: ຕົວຕັດກຽວຂອງທໍ່ນ້ຳ. (ກຽວໃນ).

22. pipe-threading dies: ຕົວຕັດກຽວຂອງທໍ່ນ້ຳ (ກຽວນອກ).

23. pipe vise: ບ່ອນຈັບທໍ່ນ້ຳໃຫ້ຢູ່ກັບທີ່.

24. pliers, assorted: ຄີມ ຊະນິດ ປີບ.

25. plumb bob: ລູກດິ່ງ.

26. portable air or electric drills: ສະວ່ານມືໄຊ້ໄຟຟ້າ ຫຼື ແຮງລົມ.

27. portable power saws: ເລື່ອຍທີ່ມີຈັກຕັດດ້ວຍຕົວເອງຊຶກໄປມາໄດ້.

28. power rodding equipment: ເຄື່ອງມືຕັດຕົ້ນເຫົາໄຊ້ກຳລັງຈັກ.

29. powered pipe-cutters, threaders and reamers: ເຄື່ອງມືໄຊ້ຕັດທໍ່ນ້ຳ ຕັດກຽວ ແລະ ຂະຫຍາຍຮູໃຫ້ກວ້າງ.

30. propane torch: ຫົວຈ໊ອດໄຊ້ກ໊າສ (pro-pane).

31. punches, assorted: ເຄື່ອງມືຕອກຮີ່ງ.

32. retractable steel measuring tapes: ແຜ່ນເຫຼັກຍາວໆ ທີ່ລັບວັດແທກ (ຊະນິດກັບຄືນໄດ້).

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MAINTENANCE MECHANICS: Plumbing Equipment and Tools (cont.)

33. screwdrivers, assorted: ໄຂຄວງ.

34. soldering irons: ເຄື່ອງຈອດ (ເຊື່ອມ).

35. spirit level: ຫົວຕັ້ງລະດັບຂນານ.

36. spring-type tubing bender: ເຄື່ອງດັດທໍ່ນໍ້າ.

37. strap wrench: ກະແຈມືໄຊ້ໝູນທໍ່ນ້ຳ.

38. swaging tools: ເຄື່ອງມືທີຫົວໜັງກີ.

39. tube cutter or reamer: ເຄື່ອງມືຕັດທໍ່ນໍ້ານ້ອຍ.

40. wrenches, assorted: ກະແຈມືຊະນິດຕ່າງໆ.